THE RHYTHM OF SPANISH PROSE

Pamela Rodriguez

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ABSTRACT

The main object of this thesis is to study the phonetic features which are responsible for rhythm in Spanish prose. The subject is first introduced within a pedagogical framework.

Chapter I is a short bibliographical survey presenting background information on speech rhythm in general and studies of the rhythm of Spanish prose in particular. The second chapter contains a brief description of Spanish phonetics and phonology, indicating problematic areas and suggesting the need for further experimentation in this field.

In Chapter III a perceptual experiment is described in which subjects were asked to identify three languages, English, French and Spanish, from non-segmental cues only. The phonetic correlates of stress in Spanish are examined in Chapter IV. Chapter V consists of a comparison of the rhythmic characteristics of English, French and Spanish prose. Phonetic features attributed to stress-timed and syllable-timed rhythms are used as a basis for this comparison. In Chapter VI features which emerge as forming the basis of Spanish prose rhythm through experimental results in the previous chapters are examined under three classificatory groupings: syllable-timing/stress-timing, word-group-timing/leader-timing, consonant-reducing/vowel-reducing.

Chapter VII concludes the thesis and summarizes all results. Spanish is classified as word-group-timed, consonant-reducing and syllable-timed, although syllable-timing is considered subordinate to word-group-timing. Areas for further research and possible applications of this type of study are also suggested.

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DECLARATION

This thesis is my original work and of my own execution and authorship.

Pamela Rodriguez.

TABLE OF CONTENTS

Page

Chapter V (continued)

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

INTRODUCTION

By way of introduction to this thesis, which basically concerns the rhythm of Spanish prose, I offer the following remarks which may seem unconventional from a purely academic point of view, but are relevant in that they summarize my reasons for embarking on a study of this type.

The majority of people these days who decide to learn a foreign language, do so for a purpose. Unless this purpose involves passing a written examination, people usually hope to communicate in the language, either when on holiday, or on business trips, or when following a course of studies in a foreign university, or on exchange visits, or what have you. Whatever the reason, the learner has to be able to make the appropriate noises in order to be understood in the language concerned, or if his role is more of a passive nature, he has to be able to interpret the stream of input noises as meaningful units. To be able to do this, he needs knowledge of the phonological systems of the language involved. These are bound to be different from his own native systems and therefore have to be taught, which not only involves teaching the pronunciation of individual sounds or segments which do not occur in his own language but also the suprasegmental or prosodic features which are so often neglected.

In fact, segmental blunders often fall into insignificance compared to a misplaced stress for example. Placing the stress on the first syllable of the word "procedure" instead of the second, even though the individual segment realization is acceptable, renders the word completely incomprehensible. This has been noted by others: "Many students learn to make the individual sounds

of English correctly enough, yet their speech remains barely intelligible to the English ear. The reason for this paradox is usually to be found in faulty rhythm and intonation." (O'Connor, 1963 : 3).

Since the early 70's, the whole face of language teaching has changed radically thanks mainly to the pioneering work of D. A. Wilkins, Council of Europe (1973) who recognized the necessity of making a break with the traditional structurally graded syllabuses and devised a type of survival kit for the foreign learner of English, according to a set of graded functions which could be expanded cyclically as the learner progressed. His ideas were followed through by Van Ek (1975), Widdowson (1978), Finocchiaro and Brumfit (1983), and others, until a few years ago, those who had not adopted this so called "communicative approach" were thought to be behind the times. However, like a new vaccine, it had not really been tried and tested before its injection into language teaching almost everywhere, and today several voices are raised in partial dissent (Michael Swan, 1985). Whatever the final outcome may be, the original change of direction, subsequent refinements and discussion all concern the teaching of competence in the use of language, including its adequacy in a particular socio-cultural and behaviourist context as well as its formal realization. The new methodology is opposed to the grading of courses simply according to increasing complexity of structures.

Such has been the furore over these developments, that phonetics in foreign language teaching seems to have been almost forgotten about or certainly left by the wayside. Perhaps it is just not

fashionable to consider phonetics as an important component in language teaching. Whatever the reason, it seems inexplicable that the most efficient instrument we have with which to communicate rapidly, using the correct structures, notions, degree of feeling, formality, informality or what have you, should be so neglected. There is little use in knowing that the best way to get a drink of beer in Scotland for you and a friend is to ask for "Two halves of special, please" if you have not mastered to a reasonable degree of proficiency, the phonemic, intonational and rhythmic systems of the language, and are unable to produce an adequate spoken realization. If, for example, someone imposed a native Spanish phonological system on this utterance, it would definitely not be understood. It might produce something like this [tu'xalβes oβ espe'θjal]*, incomprehensible to a bar-tender. By the same token (and this is authentic) an English friend of mine, fond of his wine, had managed to order his first glass successfully in a bar in Spain and asked for another. The bar-tender was horrified, asked him to repeat his order and reluctantly served him eight glasses of an extremely strong aniseed liquor! His phonetic performance had let him down of course. His native phonological system imposed on "Otro tinto" had been interpreted as "Ocho chinchon(es)". True to form, he downed the lot. Luckily he was not driving or the outcome of his deviant performance might have been tragic.

In a sense, every teacher of a foreign language is an applied linguist, and this inevitably includes being an applied phonetician. It is his job to provide a model for his students and to see that they acquire an acceptable pronunciation which will be understood

*A key to all phonetic symbols is contained in Appendix 4, page 346.

by native and non-native speakers of the target language. If, as so often happens, the newly-arrived student in the United Kingdom is unable to understand the native speaker, the likelihood is that the native speaker will not understand the student either.

I have observed all too often teachers (and very competent ones in other respects) who, in an effort to make themselves clearer to their students, convert "weak" vowels into "strong" and in so doing, distort the stress, and consequently the rhythm, completely. Students are usually eager to adopt the pronunciation which is closer to their phonological system and/or that which sounds more like what they would expect from the orthography. Both generally happen to be the distorted version. Other sweeping statements which I have heard from teachers include the following: "Intonation always rises at the end of a question", "Long vowels are always much longer than short vowels", "/p, t, k/, are said with a puff of air after them", "The vocal cords always vibrate during the production of /b, d, g/". The list of phonetic blunders could go on forever, and they do not necessarily apply just to non-native teachers. In fact, many non-native teachers are more likely to have had adequate training in phonetics and often approach the teaching of pronunciation with a greater awareness of differences and possible pitfalls due to their own struggle to perform successfully in the foreign language.

Even if some attention is paid to segmental features (which is usually the case in language courses), it is rare to find courses, or teachers, who give suprasegmental features their due. The fact is that the two are interdependent, and any attempt at teaching pronunciation through discrete, artificially divided units must

surely fail. If we accept child language acquisition as a yardstick, it would seem that the prosodic features are acquired first (Crystal, 1975:126-158). The pre-speech (or rather pre-segmental) utterances of a child of about thirteen months have pitch contours recognizable as belonging to the input language of the child. This order of language acquisition is irrelevant to a certain extent in language teaching (although it illustrates the importance of prosodic features) as the second or foreign language learner need not and indeed cannot acquire the language the same way as the child. Experience has shown however that lack of attention to prosodic features makes the job of teaching pronunciation much longer and more laborious, whereas an insistence on acceptable prosody from the initial stages can provide short cuts welcomed by the foreign language learner and especially by the adult who is almost always frustrated by the apparent disparity between English pronunciation and orthography.

For several years I taught students on the B.Ed. English Speciality course at the University of Carabobo in Venezuela. I was responsible for the English Phonetics and Phonology courses and my interest in rhythm sprang from the amazing improvement in leaps and bounds that the rhythmic component of the course produced in the pronunciation of the students. I must add here that before arriving at this stage, they had usually studied English at school for about five years and had also had five semesters at the university. The few weeks devoted to rhythm improved their fluency and comprehension to such an extent that I wished to investigate in greater detail, the reasons for this phenomenon. I had hoped to conduct an experiment with a control group and an experimental

group at the University of Carabobo to measure their improvement in production and perception after the course in English Rhythm but this was impossible. There were very few students in each semester at this stage of their course and none of them were willing to forego the rhythm component.

Consequently, my main interest in this thesis was to discover the phonetic features which are responsible for rhythmic differences between Spanish and English. A mastery of these seems to be crucial in the acquisition of L2, be it English or Spanish, no matter how proficient the students are in producing isolated sounds, different from those in their native language.

The rhythm of English speech has been studied to a much greater extent than the rhythm of Spanish. The final part of this thesis therefore deals exclusively with Spanish and attempts to unravel some of the mysteries behind Spanish prose rhythm. Whether rhythmic organization is "a sort of 'substratum' upon which other activity is built" (Lashley, 1951 : 127) or whether the rhythm of a particular language is dependent on the relative timing of the production of sounds in connected speech is a matter of conjecture. Whichever view we take, a study of the timing of these components should throw light on the rhythmic organization of the language concerned. The aim of this study is therefore two-fold: firstly to compare and contrast the rhythms of English and Spanish prose, and secondly, to examine the hypotheses concerning timing effects in Spanish which emerged from this comparison.

Chapters I and II contain background information essential to an understanding of the experiments which follow in Chapters III, IV, V and VI.

Chapter I contains a bibliographical survey of speech rhythm and the rhythm of Spanish prose. The first part is a short survey of the study of speech rhythm in general with special emphasis on English. It also contains some historical background. The second part is a survey of the studies of rhythm in Spanish prose and contains short summaries of the work of several authors.

Chapter II consists of a brief description of Spanish Phonetics and Phonology. It explains the phonological system of Castilian Spanish including the principal allophones and refers to some regional varieties of the language. Attitudes to phonetics in Spanish have traditionally been prescriptive rather than descriptive and I have suggested areas for further research.

Chapters III, IV, V and VI describe a series of experiments.

Chapter III describes two perceptual experiments designed to discover whether three languages: English, French and Spanish, can be identified by their rhythm alone and whether any assumptions can be made concerning the nature of Spanish rhythm from an analysis of errors. Reasons for the choice of these languages are given in the chapter. Forty subjects were asked to identify languages on the basis of selected utterances from a corpus consisting only of laryngographic recordings in which an attempt was made to eliminate all variables except the duration of voiced and voiceless periods and intensity.

In Chapter IV, the phonetic features accompanying perception of stress in Spanish are examined by means of two experiments. Data for the first are obtained from recordings of sentences containing the minimal stress pair "Papa/papá" and for the second, other

minimal stress pairs containing different syllable structures within the words have been used. The main features examined are duration, intensity, pitch and voicing, but principally duration, as the durational relationships between stressed and unstressed syllables are more relevant to the study of rhythm. Mingographic tracings of four native informants were segmented to obtain the data.

Chapter V contains a comparison of the rhythmic features of English, French and Spanish examined from a passage of continuous speech, "Noah's Ark". The languages are compared and contrasted within the framework of features which have been attributed to stress-timing and syllable-timing but as a result of this study, other important features emerge in relation to the specific languages. The passage was recorded by several native speakers of each language and one "typical" informant chosen for comparison, again using mingographic tracings.

In Chapter VI, timing effects in Spanish prose are examined. In the previous chapter, certain features emerged which contribute to the rhythm of Spanish prose. These are looked at under three main headings: syllable-timing/stress-timing, word-timing/leader-timing, consonant-reducing/vowel-reducing.Electrokymographic tracings from recordings by five native informants of the Noah's Ark passage and selected words made progressively longer by the addition of one syllable were used.

Chapter VII summarizes the results of the experiments in the preceding chapters and suggests further lines of research and their relevance to various applications of phonetics.

CHAPTER I

A BIBLIOGRAPHICAL SURVEY OF SPEECH RHYTHM AND THE RHYTHM OF SPANISH PROSE

The nature of rhythm is a subject which has intrigued man for many years. The majority of our habitual bodily movements such as walking, running, breathing, heart-beats, are obviously rhythmical and we are also able to impose different rhythms on movement such as when we perform dances or play an instrument. The cycles of nature in themselves are rhythmical: day and night, the seasons and growth of crops and animals, the passage of the earth round the sun, the reappearance of comets. People are aware of rhythms and will give opinions as to whether something is rhythmical or not, whether a song or a painting for example has a good rhythm or whether a rhythm has been broken. Habits which may be objectionable to others, like excessive sniffing or finger tapping or nail-biting, are also performed rhythmically.

Miyake, after studying the rhythmic structuring of various movements, found, in fact, that it is impossible not to act rhythmically (1902 : 1-48). The rhythm of natural speech (as opposed to poetry or chanting) is not usually discussed to the extent that imposed rhythms are. Adams suggests that:

> "As native speakers of a given language we early in life acquire the skill to produce the impression of proportion between the rhythm units of our utterance and the ability to recognize temporal ordering in the speech of others, and thus, usually, it is only when a speaker fails to demarcate the intervals as anticipated that we become aware of the phenomena at all" (Adams, 1979 : 2).

One controversy over the nature of rhythm itself which is

particularly relevant to the sequence of experiments in Chapters III to VI is that of "beat" versus "time". There are those who consider that it is the repetition of beats which forms the basis of rhythms and others who consider it is the repetition of equal periods of time. This controversy is amply described by Adams (1979 : 10-13) who considers it: "...a sterile exercise...since clearly the rhythmic impulse must be marked in some way for perception of rhythm to occur at all" (op. cit.: 12) and concludes:

> "It is my belief that any repeated movement (and this includes sound) over a given period of time tends to be subjectively organized into series of perceptually uniform intervals which constitute for the observer rhythmic experience, so that even if the intervals are not objectively equal, the impression gained is one of periodicity" (op. cit.: 13).

Where there are several candidates which may act as dividers of time, thereby producing several different types of intervals, those which will be perceived, in language at least, are, I believe, language-specific. Learners of foreign languages will usually try to impose their own learned rhythmic behaviour on the production of the target language and will also expect to perceive the same marked intervals as in their native language. This can often lead to a misinterpretation of attitude as for example when a foreign speaker of English responds too quickly or interrupts without respecting the rhythmic structure of the discourse and is consequently interpreted as rude. Abercrombie points out that gestures accompanying speech differ from language to language depending on the events which mark the rhythmical beats (1963 : 70-83).

The perception of periodicity of time intervals has been investigated by Allen who reports:

> "...suppose we listen to a sequence of equally spaced pulses with every other one louder. We will hear these pulses as a sequence of pairs, naturally enough, and the louder pulse will lead the group: that is, we will hear a sequence of trochees. But suppose we listen to a sequence of equally spaced pulses with every other pulse longer in duration. Again we will hear a sequence of pairs, but now the stronger pulse, i.e. the longer one, will come second in the group; we will hear a sequence of iambs. Differences in pitch act like differences in loudness, causing us to hear a sequence of trochees with the high pitch leading. If every third pulse is louder or higher in pitch, we will hear groups of three with the strong pulse leading the group; if every third pulse is longer, however, it will end the group of three. Finally, combinations of differences in loudness, pitch and duration can lead to complex rhythmic groupings." (Allen, 1975 : 77).

Allen states that for this to be linguistically valid, it would have to apply to all languages and cites Jakobson, Fant, and Halle (1951) as contradicting this principle:

> "Knocks produced at even intervals, with every third louder, are perceived as groups of three separated by a pause. The pause is usually claimed by a Czech to fall before the louder knock, by a Frenchman to fall after the louder; while a Pole hears the pause one knock after the louder. The different perceptions correspond exactly to the position of the word stress in the languages involved: in Czech the stress is on the initial syllable, in French on the final and in Polish, on the penult. When the knocks are produced with equal loudness but with a longer interval after every third, the Czech attributed greater loudness to the first knock, the Pole to the second, and the Frenchman, to the third." (Jakobson, Fant & Halle, 1951 : 10-11).

The two statements are not, however, necessarily contradictory and I believe that in our perception of language rhythms, both may be valid. Jakobson et al. first refer to a series of equally spaced knocks with every third louder, which are perceived in differently ordered sequences by speakers of different languages. (Allen's subjects were presumably native speakers of English.) Their perception is obviously coloured by their own linguistic experience which is natural enough as no other stimuli are included to affect the perception of the groupings. Allen states earlier

in the same article that "Any grammatical rule, whether syntactic or phonological, which affects the order of closely-related formatives in a systematic way will have an effect on eventual rhythmic structure of the phrase." (op. cit.: 76). The second set of knocks (Jakobson) were equally loud but with a longer interval after every third. The knocks were perceived in the same sequences of three with the longer space falling group finally in accordance with Allen's claims but again difference in loudness was heard on knocks occupying different positions. In both cases, the louder knock (whether presented or perceived as louder) corresponded to the position of word stress in the languages of the subjects. It is interesting that the "beat", if one considers the beat to correspond to the stimuli perceived as louder, does not necessarily correspond to the boundaries of the time intervals. In the case of the Polish listeners, the boundaries of the rhythmic intervals occur between two of the softer beats, with the louder stimulus perceived as central to the group.

Speakers of different languages therefore have different perceptions of rhythm acquired from constant use of their own language. These acquired differences have their bases in the language itself and although the "temporal sequencing of similar events" (Dalton and Hardcastle, 1977 : 41) may result from phonological, lexical and syntactic features, it must also be realised at the phonetic level. I am not of the belief that perception can be divorced from production or vice-versa.

The three languages I have chosen to compare in this study are English, French and Spanish, with a view to isolating those phonetic features which contribute to the rhythm of Spanish prose. These

three languages are certainly perceived as having very different rhythms and if English and Spanish listeners had been substituted for Czech and Polish respectively in the experiment described above, the results might very well have been the same, as Spanish words are usually stressed on the penultimate syllable, and one might suppose that this linguistic experience would have an effect on a native speaker's perception (cf. pp.36-39 of this chapter).

The following sections contain a brief summary of studies relating to Speech Rhythm and the Rhythm of Spanish. Section 2 unavoidably refers mainly to English as this language has been studied in greater detail than any other.

2. Speech Rhythm

Any study of speech rhythm must necessarily include reference to the theory of stress-timing and syllable-timing. The terms were first coined by Pike in his "Intonation of American English" in 1945. They quickly caught on and the distinction between them was exemplified very explicitly by Abercrombie:

> "As far as is known, every language in the world is spoken with one kind of rhythm or with the other...French, Telugu and Yoruba ... are syllable-timed languages, ...English, Russian and Arabic ... are stress-timed languages." (Abercrombie, 1967 : 97) (see pp.15,16, this chapter).

Miyake found that simple successions and alternations are most prevalent in all our movements (1902) and Allen equates this phenomenon to language rhythm, a rhythm of succession relating to those languages which do not have stress, or do not have it to the same degree as English, and a rhythm of alternation to those languages like English in which "...the onset of the nuclear vowel of a stressed syllable is a rhythmic 'focus' in the speech..."

(Allen, 1968c: 67). He qualifies this distinction between language rhythms however, by adding the rather cagey remark that "...there is a definite tendency toward alternation of accents in many and perhaps all languages." (Allen, op. cit.: 67).

The theory of alternation in language rhythm is certainly not new. One of the earliest empirical studies of the prosodic features of language was that of Joshua Steele in his "Essay towards establishing the melody and measure of speech" (1775) written in reply to the assertion made by Lord Monboddo in "The Origin and Progress of Language" that "the music of our language...(is) nothing better than the music of a drum in which we perceive no difference except that of louder or softer" (Steele, 1775). He not only showed pitch contours in his intonation but also that the rhythmic unit of speech was composed of a "thesis" and "arsis", thesis corresponding to the strong part of the unit and arsis to the rest of the foot. He recognized that feet could be made up of different numbers of syllables and that these syllables could be different lengths so as to maintain the regular beat. He also anticipated the theory of silent stresses indicating that they are an essential part of the rhythmic structure of English. (For a development of the study of English speech rhythm from the times of Joshua Steele to present times, see Adams, 1979 : 22-57).

Andre Classe observed that: "isochronism is probably the essential character of the rhythm of English prose", but qualified this by saying it can only be present when the following conditions are met:

"a) Similarity of phonetic structure of the groups including number of syllables
b) Similarity of grammatical structure of the group, and similarity of connexion between the groups."
(Classe, 1939 : 100).

The theory of isochronous stresses as being fundamental to rhythms of certain languages was popularized by Pike. He expands Classe's theory:

> "The tendency toward uniform spacing of stresses in material which has uneven numbers for syllables within its rhythmic groups can be achieved only by destroying any possibility of even time spacing of syllables. Since the rhythm units have different numbers of syllables but a similar time value, the syllables of the larger ones are crushed together and pronounced very rapidly, in order to get them pronounced at all, within that time limitation. This rhythmic crushing of syllables into short time limits is partly responsible for many abbreviations - in which syllables may be omitted entirely - and the obscuring of vowels; it implies, also, that English syllables are of different lengths, with their length of utterance controlled not only by the lexical phonetic characteristics of their sounds but also by the accident of the number of syllables in the particular rhythmic unit to which they happen to belong at that moment." (Pike, 1945 : 34).

This adequately describes the theory of isochronism in English prose rhythm, although Pike did not go so far as to say that the groups were isochronous. Abercrombie - advocate of the theories of stress-timing and syllable-timing - has made the following statements about rhythm:

> It is of great pedagogical importance and should be the first thing to be tackled when teaching a language.
>
> The basis is essentially muscular: each syllable corresponds to a chest pulse and each stressed syllable to a reinforced chest pulse (Stetson, 1951). It is difficult for people to change their muscular habits.
>
> Speech rhythm is based on combinations of these two trains of pulses: in languages such as English, the reinforced chest pulses recur at regular intervals producing a stress-timed rhythm, in languages such as French, pulses producing syllables recur at regular intervals producing a syllable-timed rhythm.
>
> In English, this tendency is constantly trying to assert itself in spite of other factors working in other directions.

> The two types of rhythm are incompatible but languages may change from one type to the other.
>
> The phonological unit of rhythm in English is the foot containing one stressed syllable plus all other syllables up to but not including the following stressed syllable. The length of an utterance will depend on the number of feet it contains, not the number of syllables, but syllable quantity within the foot can change its meaning, e.g. The judge's horse/The judge is hoarse. (Abercrombie, 1979).

The theory of isochronism has been questioned by several linguists, among them Shen and Peterson (1962), O'Connor (1965, 1968), Crystal (1969), Rees (1975). None of them found interstress intervals to be objectively isochronous. Shen and Peterson did spectrographic analyses of various prose readings and found interstress intervals to be far from isochronous (although they did not take into account perceptible differences), however they intimated (rightly in my opinion) that the theory of isochronism could be a useful teaching device when it is contrasted with foreign languages in which syllables occur at regular intervals.

O'Connor also conducted a series of experiments to discover whether physical isochrony is present in English prose, whether durations of interstress intervals are affected by their segmental structure and to what extent subjects' perception of time intervals as equal corresponds to physical reality (O'Connor, 1965, 1968). Measuring the durations of stress groups in five sentences containing equal numbers of syllables, he found there was no physical isochrony between stress groups and that group duration was affected by the segmental structure of the component syllables (O'Connor, 1965 : 11). In a later experiment he inserted the following items / ses, sets, sekts, seksts, speksts, spreksts, spreiksts / into the frame "Take _____ Park", hypothesizing that if isochrony were present,

the duration of the variable would not alter in relation to the frame items, i.e. that the frame items would increase their duration proportionately or that the duration of the segmental components of the variable would decrease as their number increased. The following results were obtained:

> "1. There is no evidence that the frame items accommodate their duration to that of the variable.
> 2. The variable has a clear tendency to greater duration as segmental length increases.
> 3. The duration is...not directly proportional to the number of segments : there is therefore a compressive tendency which might correspond to the tendency to isochronism mentioned in phonetic literature." (O'Connor, 1968 : 2-3).

In an experiment in which he tested subjects' judgements of equal time intervals using electrically generated clicks, he found that times tended to be considerably different before they were judged as such. 50% of the subjects judged intervals to be equal when one was always 340 ms and the other ranged from 320 to 375 ms. He also found there was a sequence effect (i.e. jump in time interval caused these to be judged as different). (O'Connor, 1965 : 12).

Although these experiments undoubtedly have their value, I think it is dangerous to make generalisations about "real" speech on the basis of the results. As will be seen in the experimental part of this study, syllables such as /spreksts/ and even /sekts/ are extremely rare in English and that they should occur in a 3-syllable utterance, with each syllable stressed is even more improbable. The effort to isolate a variable almost inevitably leads to unnatural utterances and results should be interpreted with caution. In this case, frequency of occurrence of the variable should be taken into consideration plus phonetic context - the fact that syllables of complex structure are normally adjacent to ones of simple structure.

The domain of isochrony had been stated by Classe to be the sentence "...it should be understood that each sentence should be treated as an independent unit : the rhythmic scheme ends on the last stress of a sentence; a new one begins with the next sentence." (Classe, 1939 : 87) but this was further questioned by Rees who maintains that the domain of isochrony is the tone group and not the utterance. From his data in Welsh (also a "stress-timed" language), he states that "...the notion of isochrony is not an acceptable one - certainly not phonetically, and perhaps involves too many irregularities of too great a magnitude for its acceptance as a phonological process either", but decides to "accept isochrony as a feature of the rhythm" placing "constraints on the unit within which it operates": in other words, accept isochrony, but dismiss the utterance as its domain. "...it was found on close scrutiny of the data, that the best description was obtained if the tone-group was taken as the phonological unit within which isochrony operated as a feature of the rhythm" (Rees, 1975 : 21).

This may be a phonetic universal. If changes in speech rate occur which would affect the absolute duration of stress groups or syllables, they are less likely to do so within a tone group than between tone groups.

Uldall (1971) and Lehiste (1973, 1977) both concluded through experimental work that there was evidence in favour of isochronism in spite of differences in foot duration. Lehiste took 17 sentences each of 4 metric feet which contained monosyllabic and disyllabic feet in each of the four positions. She found some large durational differences but many were so small that they did not exceed her previously established 10% variable of perceptible difference for

feet in the range of 300-500 ms. Moreover, she found that in order to get a significant agreement on differences in duration of intervals, an increment was needed that ranged from 30 to more than 100 milliseconds. Differences smaller than 30 ms were never reliable. In the passage analyzed in Chapter V of the present study, one and two syllable feet make up well over 50% of all foot types and durational differences amongst these are minimal.

Pike mentioned Spanish as his prototype of a syllable-timed language:

> "Many non-English languages (Spanish, for instance) tend to use a rhythm which is more closely related to the syllable than the regular stress-timed type of English: in this case, it is the syllables instead of the stresses, which tend to come at more or less evenly recurrent intervals - so that, as a result, phrases with extra syllables take proportionately more time, and syllables or vowels are less likely to be shortened and modified...The type may be called a SYLLABLE-TIMED rhythm unit." (Pike, 1945 : 35).

The physiological basis for the distinction between syllable-timing and stress-timing was established by Stetson in 1951, and later refuted by Ladefoged in 1967. However, it has been considered a useful distinction by many linguists, including Abercrombie (1965), Ladefoged (1967, 1975), Corder (1973), O'Connor (1973), Allen (1975), Catford (1977), Lehiste (1977), Adams (1979), Major (1981).

Not so much has been written on languages purported to be syllable-timed. Most of the literature concerns French but strangely enough, rhythm does not seem to have captured the interest of French phoneticians; in fact, one wonders whether it is considered important linguistically by native speakers. One can certainly think of examples of minimal stress pairs but not restricted to the phonological word. Several are quoted in a recent article by Wenk:

> "/Nicole / a bouffé / des huitres / au p'tit dejeuner./
> (Nicole had oysters for breakfast)

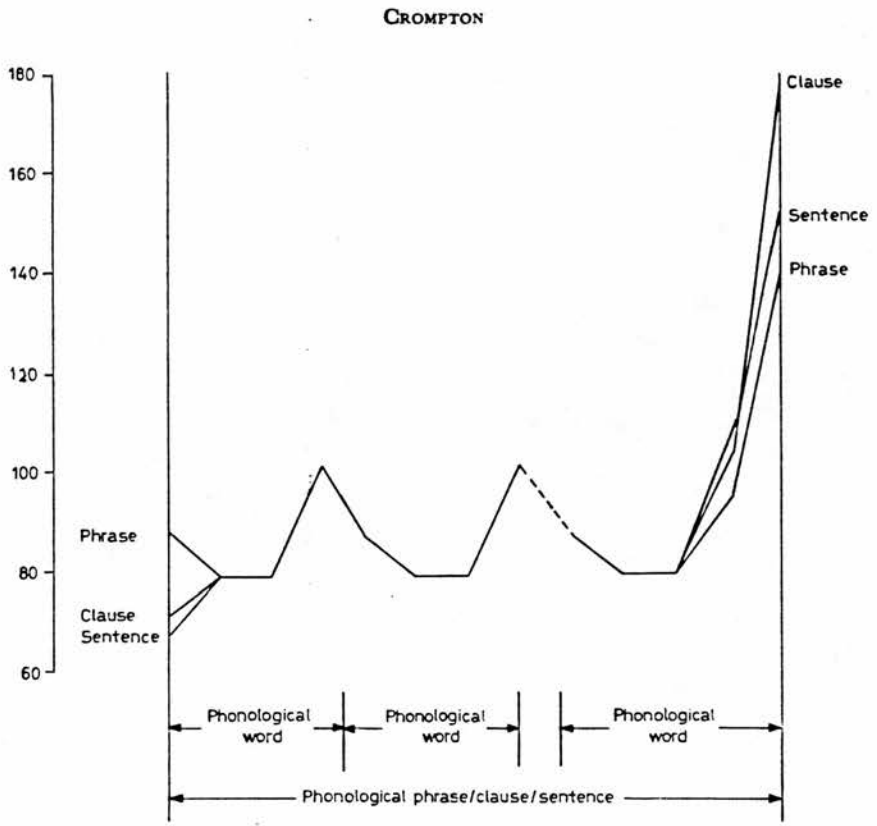
/Nicolas / bouffait / des huitres / au p'tit dejeuner./
(Nicolas used to have oysters for breakfast.)
[nikolabufɛdezɥitʁoptidezøne]
(Wenk, 1985 : 159)

Studies of timing in French have reported word-final and phrase-final syllables to be much longer than the others (Delattre, 1966, 1969; Smith, 1976; Crompton, 1980; Ickenroth, 1981; Wenk and Wioland, 1982; Wenk, 1985). Delattre, who studied the durational features of English, French, Spanish and German, reported "it is French which, of the four languages, shows by far the widest ratio of lengths from stressed to unstressed syllables" (Delattre, 1966 : 190).

Crompton divided his material into various phonological units (words, phrases, clauses, sentences) and measured the durations of syllables in various structural positions, using four native speakers. He also compared accented and unaccented syllables for a number of different positions in the tone group (made up of one or more of the above phonological units). It is not absolutely clear what he means by "accented" but I suppose the term refers to syllables which are perceptually prominent. When these syllables were not final of any of the above mentioned phonological groups, they were not longer than unaccented syllables. He therefore concludes that increments in syllable duration are due to their position within the phonological unit to which they belong. Fig. 1 reproduces a graph summarizing his results. The figures on the left express the ratios in percentages of the duration of component syllables to their expected duration, calculated from their inherent lengths (Crompton, 1980 : 231-233).

Figure 1

Underlying timing pattern for French utterances (Crompton, 1980 : 232)



It is interesting that syllables perceived as "stressed" (see Note on Terminology, p.439) coincide on the whole with these phonological group markers and differences in duration between these and other syllables are substantial. It is not surprising that recent investigators are dissatisfied with the classification of French and other languages as syllable-timed if investigation shows there is greater variation in syllable duration than in the so-called stress-timed languages, or that there is very little difference in variability and mean durations of interstress intervals between languages.

In 1983, Dauer published an article summarizing the results of a study in which she examined data from English, conversational Thai, Spanish, Italian and Greek. Each speaker read a passage from a modern play or novel (approximately 1.5-2 minutes) and measurements were made on 4 channel mingograph tracings from stressed vowel onset to stressed vowel onset. The results are reproduced in Table 1. It can be seen that the mean duration of interstress intervals varies very little from language to language in spite of the fact that English and Thai are reported to be stress-timed and Spanish, syllable-timed. After applying statistical tests to the data, she found that there were no significant differences between languages and that individual speaker differences reflected differences in speech rate. In fact, there were significant differences between speakers of the same language! She proposes that "rhythmic differences we feel to exist between languages such as English and Spanish are more a result of phonological, phonetic, lexical and syntactic facts about that language than any attempt on the part of the speaker to equalize interstress or intersyllabic

TABLE 1

Mean durations of interstress intervals (in cs)
(Dauer, 1983 : 53)

	Number of syllables in interval									Mean rate
	1	2	3	4	5	6	7	Mean	S.D.	syll/s
English										
AK	29	39	50	54	66			45	13.1	5.9
SD	30	43	54	65.5	(68)			48	14.2	5.0
[1]	42	47.5	54	76				53	14.7	4.6
[2]	32	44	62	69				51		
Thai										
[3]	30	42	55	(58)	(68)			38	11.3	4.5
Spanish										
JF[1]	(13)	29	38	49	59	(72)	(64)	43	14.5	8.0
JF[2]	(20)	32.5	42	54	65	76	85	48	15.5	7.2
GP	22	37	52	60	71	94		52	17.7	6.1
Greek										
OS	19	29	38	48	59.5	64		43	14.1	8.0
DM	(20)	31	43	53.5	66	74	95	48	17.6	7.3
KM	(25)	34	44	56	68	75	(91)	54	17.0	7.1
Italian										
LM	(19)	31	41	51	62		(88)	45	14.5	7.5
GC	(24)	33	44	55	65	(79)	(91.5)	48.5	14.6	7.1

Note: Parentheses are around averages based on fewer than 4 examples.
[1] : Uldall (1971 : 206-207) Reading of 'The North Wind and the Sun' in R.P., 40; interstress intervals.
[2] : Wallin (1901 : 105) Averages for 10 speakers reading prose and poetry, total of 366 interstress intervals.
[3] : Luangthongkum (1977 : 167-168) Reading of 'The Story of a Myna Bird', 74 interstress intervals.
S.D.: Standard deviation.

intervals" (Dauer, 1983 : 57). She claims that the three main areas in which the groups differ are: a) Syllable structure, b) Vowel reduction, and c) Stress. She also believes that languages "can be compared to each other along the dimension of having a more or less stress-based rhythm:

——————————————————————→ stress-based

Japanese, French, Spanish, Greek, Portuguese, English" (Dauer, 1983 : 59-60).

These results will be referred to later in detail but one comment is not inappropriate here. Earlier in the paper she states that "the difference between languages such as English and Spanish has to do with what goes on within rather than across interstress intervals (op. cit.: 55). Here I would like to refer back to the introduction to this chapter and the section reporting the experiment on perception of groupings. If stressed syllables do not necessarily fall in the same position within the sequence of events which form rhythmic units in different languages, measurements of interstress intervals such as those quoted above may not necessarily reflect the rhythm organization. I would prefer to rephrase the above remark and say that the differences between languages such as English and Spanish have to do with what goes on within rather than across rhythmic groups.

In 1982 Roach also investigated interstress intervals using tape-recordings of French, Telugu and Yoruba (syllable-timed languages) and English, Russian and Arabic (stress-timed languages). His stress groups were measured from the beginning of stressed phonological syllable to the beginning of the following, mentioning that if P-centres could be identified (Morton et al., 1976), these

could possibly be used as points for measurements but at present it is "intuitively more satisfying" to use the phonological syllable (Roach, 1982 : 76). In order to avoid effects of varying tempo between speakers, each tone group was measured and the result divided by the number of interstress intervals it contained. Each interstress interval was then measured and compared with its predicted value. The variance of the percentage deviations was calculated for each language and is reproduced below:

French	617	English	1267
Telugu	870	Russian	917
Yoruba	726	Arabic	874

(Roach, 1982 : 77)

Roach considers this sufficient evidence to reject the hypothesis that syllable-timed languages would exhibit a wider range of percentage deviations in interstress intervals. He also compared the duration of interstress intervals according to the number of syllables they contained and found that the above languages could not be separated into two groups on the basis of the results either. He concludes that the basis for the distinction is "auditory and subjective" (p.78), at the same time hinting that what is required is "a thorough examination of the factors that might be responsible for languages sounding syllable-timed or stress-timed" (op. cit.: 78).

There is therefore a considerable degree of dissatisfaction with the terminology but few phoneticians have actually carried out a "thorough examination" of the above-mentioned factors. Two studies by Wenk and Wioland (1982) and Wenk (1985) are notable exceptions. It has already been mentioned that phonological word or phrase-final syllables in French are much longer than non-final. These

are almost always the "accented" syllables in French, and taking this as his starting point, Wenk explains his reasons for characterizing English as a leader-timed language and French as a trailer-timed:

> "These groupings (French rhythmic groups) may be usefully related to a feature of human perception noted by psychologists and linguists (Woodrow, 1951, p.1223; Fraisse, 1974, p.74; Allen, 1975, p.78) which is the fact that longer auditory stimuli not differentiated by a concomitant increase in intensity from neighbouring sounds within certain series are attributed by listeners to final position in their rhythmic groups. Interestingly, the role of pitch appears to be less clear-cut (cf. Bell, 1977, p.5), it being as likely to vary on group initial syllables as on group finals. (However, one should note the tendency cited below for French to delay pitch-change to the final portion of an accented word's total duration, in contrast to the English pattern of less gradual pitch-jump). It may, therefore, be anticipated that the regularly lengthened accented syllables of French, whose vowel intensities (cf. Delattre, 1966, p.187) are some 0.5 dB lower than for unaccented vowels, should be perceived at the ends of their rhythmic groups, whilst the "stressed" syllables of English (cf. Delattre's report for English of a 4.4 dB differential in favour of stressed vowels) are attributed to initial position in their groups. The respective group-final and group-initial accents of French and English are exemplified in (4) and (5):
>
> (4) /Am**broise**/ étu**die**/ a l'universi**té**/de Pa**ris**/
>
> (5) /**Am**brose is/ **stu**dying at the Uni/**ver**sity of/ **Pa**ris/
>
> (Note: accented syllables appear in emboldened type)."
> (Wenk, 1985 : 159-160).

Backed up by further acoustic data, he establishes the characteristic features of trailer-timing and leader-timing. These are reproduced here in Table 2. He qualifies the generality of his classification however by saying that they need not necessarily apply to other languages. It seems to me that this is a very useful way to treat rhythmic differences between French and English and his theory will be referred to in greater detail in Chapter V.

On the whole, rhythm has not been dealt with very satisfactorily. One of the reasons for this is perhaps that it is an extremely

Table 2

Characteristic features of trailer-timing and leader-timing

		Trailer-timing	Leader-timing
Accented syllables			
1.	Position	Group-final	Group-initial
2.	Duration	(±lengthening)	(±lengthening)[a]
3.	Intensity	(-intensity increment)	(+intensity increment)
4.	Intonation	Delayed pitch change	Pitch jump
5.	Articulation	Explicitness of articulation	Explicitness of articulation
Unaccented syllables			
1.	Tension	Relatively tense	Relatively lax
2.	Centralization	Vowels weakly centralized	Vowels markedly centralized

[a]If accented syllables in leader-timing tend to be longer than unaccented syllables, there are many cases where the opposite is true, as shown in Abercrombie (1964).

(Reproduced from Wenk, 1985 : 161)

difficult feature to define and isolate. In addition, most of the researchers have been native speakers of English and as such, are bound to have their perceptions and therefore hypotheses, coloured by their native language. It is not necessarily essential to be a native speaker of the language (or languages) under investigation but familiarity is certainly an advantage when dealing with rhythm (cf. Chapter III). It is also a rather prescriptive attitude to assume that rhythmic groups in other languages should have their component syllables in the same order - that the "stressed" or "accented" syllable should lead the group. The acoustic correlates for prominent syllables need not be the same - they may be different or differ hierarchically as shown above in Wenk's characteristic features. Lastly, the categories languages could be assigned to need not be stress-timed or syllable-timed. The fact that languages have been assigned to one or the other group shows there are differences between languages supposedly of the same group. One of the most prominent features which identifies a native speaker of French when speaking Spanish is his deviant rhythm, and yet both languages have been classed as syllable-timed.

3. The Rhythm of Spanish Prose

Where does Spanish fit in? Can the rhythm be adequately described as syllable-timed or stress-timed? Spanish, in common with English, has phonological word accent. There are many verb pairs and verb-noun pairs, distinguished by accent alone. The former can quite easily cause ambiguity unless the accented syllables are phonetically distinguishable from the others because firstly, the words occur in the same syntactic positions and secondly, in spoken Spanish, it is usual to omit pronouns, so the person is determined by the

accented syllable and the verb ending. The following are examples:

Noun	Verb	Verb
Término (term)	Termino (I finish)	Terminó (he finished)
Cántara (jar)	Cantara (pret. subj. sing)	Cantará (he/she will sing)
Pícara (rascally adj.)	Picara (pret. subj. sing)	Picará (he/she/it will sting/itch)
Encaje (lace)		Encajé (I fitted in)
	Llegue (pres. subj. arrive)	Llegué (I arrived)

Unlike the majority of verb-noun pairs in English, e.g. accent (N) ['aksənt], accent (V) [ək'sent], there is no noticeable change in vowel quality in Spanish - surely all the more reason why the accented syllables should be differentiated from the others by means of suprasegmental features. To quote Navarro Tomás "Most Spanish words have a unique and invariable stress. Any error in stress deforms the normal configuration of the words to the point of making them in some cases unrecognizable" (Tomás, 1968 : 54). It would seem therefore that Spanish should have more in common rhythmically with English than with French. Certainly, unlike French, timing and rhythm in Spanish have been the object of quite a number of studies by Spanish and South American phoneticians, although many of them have been concerned with poetry rather than prose.

Much pioneering work in Spanish phonetics was done by Navarro Tomás in the first half of the century and published in a series of articles in the "Revista de Filología Española". In 1916, he made kymographic tracings of words which he had recorded himself, leaving a brief pause in between each word. The object was to measure accented vowels in three syllable positions; syllable final, penultimate

and ante-penultimate. The Spanish terms for these are "aguda, llana, esdrújula" respectively. Example, "anís" (aniseed), "pisa" (he/she steps on), "víspera" (the day before). His results are summarized as follows:

"esdrujulas"	6.5-10	centiseconds, a range of	3.5 cs.
"llanas"	7-14	" "	7 cs.
"agudas"	11-20	" "	9 cs.

He claims that there is no point of contact between "agudas" and "esdrújulas" and that everything else being equal, the vowel is always shorter in closed syllables than in open. He concludes that "la duración de una vocal disminuye a medida que aumenta el número de los sonidos que le siguen dentro de la misma palabra o grupo acentuado" (the duration of a vowel decreases proportionately as the number of sounds which follow it within the same word or accentual group increases) (Navarro Tomás, 1916 : 398).

Average durations of the five Spanish vowels showed that the closer the vowel, the shorter it is:

	i	e	a	o	u
Average duration	11.72	12.24	12.67	12.32	11.95
Proportion	0.92	0.96	1	0.97	0.94

The results of measuring durational differences according to the structural position of the stressed syllable in the word would seem to indicate a certain amount of speaker manipulation but one has to take into account that words were said in isolation with a short pause between each. This would automatically lengthen word final vowels so it is impossible to know to what extent the position in the word is responsible.

In a second article on unaccented vowels in 1917, he found that they are always shorter than accented, everything else being equal and that the more syllables there are, or the further the vowel is removed from the tonic, the shorter it gets. He supposes that there is no difference in intensity, although the ear perceives a kind of secondary stress in words like "timidez" (shyness), "puritano" (puritan), on [ti] and [pu], explainable, he claims, by an "acento rítmico" (rhythmic accent) (Navarro Tomás, 1917 : 374-377). He repeats this idea in 1921, "El acento es indudablemente el más importante elemento rítmico de la lengua española y el fundamento de nuestra versificación" (The accent is undoubtedly the most important rhythmic element in the Spanish language and the basis of our verse) (Navarro Tomás, 1921 : 57). Is he hinting at a type of stress-timing for Spanish? Later, in his standard work on Spanish Intonation, he defines the rhythmic groups as semantic units which are the components of tone groups, for example:

> "/Por el fondo/de la calle//pasaban/en cuadrillas/
> los soldados//"
>
> / = rhythmic group boundary; // = tone group.
>
> (/At the end/of the street//were passing/in groups/
> the soldiers//) - Literal Translation.
>
> (Groups of soldiers were going past the end of the street)
>
> (Navarro Tomás, 1948 : 39).

In 1938, Gili Gaya carried out an experiment to investigate rhythm in Spanish Prose. He asked 60 subjects, native speakers of Spanish, to repeat the syllable (ta). Fifty-six of these grouped the syllables ('tata 'tata 'tata). When the timing was imposed by a metronome, subjects performed best at "andante" (66 beats per minute), beats presumably coinciding with stressed syllables, which would mean the sequence ('tata) was uttered every 91 centiseconds,

extremely slow for continuous speech. Gili Gaya concludes from this that there is a tendency in the language for a stress based rhythm of a binary trochaic type (Gili Gaya, 1938 :376). This can hardly be equated with actual continuous speech. The average number of syllables per stress group in Spanish is much closer to three than two (cf. Chapter VI, p. 298).

In a later article (Gili Gaya, 1940 : 287-298), he examines a prose passage read by one speaker. His justification for using only one speaker is that it is the relative durations of the syllables which are important, not the absolute, and that relative durations are only valid for one speaker at one particular time. He divides the sentences into three parts, "rama inicial" (all sounds up to and including the first accent), "rama intermedia" (all sounds situated between the first and last accent) and "rama final" (final accent and all sounds following) and finds that differences between stressed and unstressed syllables decrease in the "rama intermedia". (For a criticism of this, see Pointon, 1978.) He finds that the more complex a syllable, the longer it is and terms this "cantidad por naturaleza" (intrinsic duration?) which is working against an isosyllabic tendency, particularly in the "rama intermedia". He notes however that "En los grupos fónicos largos es curioso observar que cuando los acentos se hallan muy distantes, las sílabas comprendidas entre ellos tienden a abreviarse como si se precipitara el 'tempo' de la lectura en busca de un acento en que apoyarse". (In long utterances, it is strange to observe that, when accents are very far apart, the syllables between them tend to be shortened, as if the reader increased the speech rate, searching for accentual support) (Gili Gaya, 1940: 296). He adds that the attenuation of

differences between accents is an important point when investigating the prosodic structure of the language. These remarks could also indicate some kind of stress-timing.

Both Gili Gaya and Navarro Tomás consider "accented" syllables as important in the rhythmic structure, but Navarro Tomás believes that their phonetic realization depends on the type of groups they are contained in. These groups are defined as "minimal fractions of the speech with definite semantic value" (they correspond to my syntactically-defined groups, cf. Chapter V). He states that "the movement of these phonological units, with its impulses concentrated, extended, increasing or decreasing, is the base on which the language depends for most of its stress effects" (Navarro Tomás, 1968 : 58). He gives an example from Antonio Machado "El poeta- exhibe- su corazon- con la jactancia/ del burgués- enriquecido- que ostenta- sus palacios". (The poet exhibits his heart in the same way that the newly rich shows off his palaces.) These obviously do not correspond to English feet. He goes on to say that as weak elements generally precede strong ones, this gives the stress of the group a rising form: rising I interpret as increasing in intensity and pitch. Intensity is the constant correlate of accent according to Gili Gaya, "la intensidad física es su elemento caracterizador y constante" (physical intensity is its characteristic and constant element) (Gili Gaya, 1958 : 33). These ideas coincide to a certain extent with Wenk and Wioland's (cf. Chapter V, 2.3.3.1).

Delattre (1966) and Olsen (1972) both compared stressed and unstressed syllables (open and closed) in final and non-final positions. Delattre made spectrograms of five minutes spontaneous speech by a native speaker (South American presumably) and Olsen analyzed

half an hour's speech by a well-known Mexican artist. Olsen divided his material first into "sense groups" from which he found 139 different rhythmical patterns but only 20 of these contained just one stressed syllable. It is not clear how he defined the "sense group" but they obviously do not correspond to Navarro Tomás' rhythmic groups.

The results of both are summarized here. Figures are in centiseconds.

	Stressed		Unstressed	
	Delattre	Olsen	Delattre	Olsen
Final				
Closed	32.13	31.44	23.03	23.60
Open	24.50	26.47	18.52	17.16
Non-Final				
Closed	25.88	23.92	19.27	18.97
Open	20.23	17.77	18.16	13.67

The results show many similarities. Open syllables are all shorter than closed and stressed syllables all longer than unstressed in their corresponding groups. The ratio of stressed to unstressed syllables is smaller than that for English. An interesting point to note is that the most common syllables have the smallest differences in duration between stressed and unstressed. These are non-final open syllables, stressed and unstressed. Delattre's averages are 20.23 and 18.16 centiseconds, a difference of 2.07 cs (ratio 1.11:1) and Olsen's 17.77 and 13.67, a difference of 4.1 cs (ratio 1.3:1). The difference in Delattre's figures is minimal. The greater difference in Olsen's figures is probably due to the fact that the speaker was Mexican. I have noticed that of all

varieties of Spanish, both peninsular and from the American continent, Mexican is the one in which vowel reduction is most common. My Mexican and Venezuelan informants' data showed these speakers' ratios between stressed and unstressed syllables to be greater than those of the peninsular Spanish speakers (cf. Chapter IV, Tables 16 and 23 and Chapter VI). Olsen also found the "typical" rhythmic pattern to be composed of 4 syllables, 2 unstressed, 1 stressed, 1 unstressed and in his data, stressed syllables were more likely to be closed than unstressed (cf. Chapter V).

In 1974, Pinkerton published a paper on Spanish Vowel Sandhi (more widely known as "sinalefa", see Note on Terminology p.440). Accepting Spanish as syllable-timed, she writes "Vowel sandhi may be triggered by contiguous vowels, but the process which accomplishes the reduction is controlled by syllable-timing" and "...the two entire contiguous syllables...must be collapsed within the unit length allotted to one syllable" (Pinkerton, 1974 : 184, 185). She gives some rather dubious examples: "como uvitas" [komuβitas] (I eat grapes), "esta hija" [estixa] (this daughter). These may be used in the South Texan dialect she was investigating, but I have only heard them reduced to diphthongs. Later in her Ph.D. thesis (1976), she reports on the control of rhythm and temporal relations through 10 native speakers of Spanish and one bilingual K'ekchi-Spanish in various stages of learning English. First she recorded a series of nonsense words said by native speakers in Spanish and English and established there is greater difference in duration between stressed and unstressed syllables in English and also greater prepausal lengthening. The ratios for Spanish stressed to unstressed ranged from 1:1.01 to 1:1.58. All stressed syllables were higher in pitch for Spanish

(this is not necessarily the case in continuous speech) whereas they were both higher and lower for English than the previous syllable, but with smaller ratios. All the learners managed to lengthen stressed syllables but only two learnt to lengthen utterance final syllables. From this she concludes that "final syllable lengthening in English is not a separate suprasegmental parameter on a par with stress or intonation, but rather a consequence of the relationship between pre-pausal intonation cues and stress-timing" (Pinkerton, 1976 : 26). She also found that native English speakers' judgments of the pronunciation of her learners after three months correlated well with their ability to lengthen stressed and pre-pausal syllables. This experiment does not prove that Spanish is syllable-timed and English stress-timed, but shows that the concept of stress-timing can give rise to useful teaching aids when the learners are native speakers of Spanish.

Pinkerton's results on duration were corroborated in 1979 by Berinstein who compared the perception and production of stress in English, Spanish and K'ekchi. Taking as a starting point the affirmation by Jakobson et al. (1951) (cf. Introduction to this Chapter) that the syllable which subjects expect to hear as stressed will depend on the phonological and phonetic regularities of their native language, she conducted the following experiment. Stimulus material was presented to 3 groups of subjects, native speakers of English, Spanish and K'ekchi respectively who were required to say which syllable they heard as more prominent in groups of four syllables with pauses in between each group. The basic syllable was a synthesized [bɪ] on a monotone of 100 Hz, with a total duration of 140 ms., 40 (consonant) and 100 (vowel). Three of the syllables

were given this duration whilst the vowel of the other was given one of six durations: 70, 100, 120, 140, 160, or 200 ms. The subjects were asked to mark one of the syllables in each group as "stressed". K'ekchi is a language spoken in Guatemala which has phonemic quantity but does not use duration as a stress correlate. Words are always stressed on the final syllable.

The results were interesting. In K'ekchi, the position was highly influential, i.e. fourth position was judged as stressed more often than the other three regardless of which syllable carried the extra duration. In Spanish, the reverse was true: duration influenced stress perception irrespective of position. In English both position and duration were significant. Long vowels in initial position were judged as stressed and this decreased until final position. Duration, however, was the most important factor in judging syllables to be stressed, much more important than in Spanish. When all syllables were the same length, the same results were obtained for English and Spanish respectively as far as position was concerned. The 60 and 100 ms. increments had a small effect in Spanish but a large effect in English. Berinstein explains this by saying that "such increments (1.6 to 2.0:1) are a novel experience to a Spanish listener and will not immediately be associated with the linguistic function of stress, given the fact that there is an upper limit of 1.5:1 to variability in Spanish vowel duration as opposed to English 3.5:1 (cf. Delattre, 1966)" (Berinstein, 1979 : 21). She considers that, although Spanish has a preference for penultimate stress, the fact that Spanish-speaking listeners showed no bias for any position over any other is not surprising due to the possibility of stress occurring on any syllable. The

following examples are given: "libro" (book), "libró" (she/he delivered), "término" (term), "termino" (I finish), "terminó" (she/he finished), "dígaselo" (tell it to him/her) (op. cit.: 22).

It is suggested that the preference of the English speakers to judge first syllables as stressed is due to the fact that:

> "...when processing incoming speech signals which do not provide the necessary acoustic information for predicting segmentation ...rhythm is used as an organizing principle in the perception of English and it is for this reason that the first syllable is perceived as longer, louder, or accented relative to the other syllables in the word" (op. cit.: 24).

Is it possible to take this a step further and say that the position of the stressed syllable within groups in Spanish is not used as an organizing principle as in English but rather it is the repetition of the groups themselves that is the organizing principle? One small criticism of the experiment concerns the fact that groups of four syllables were used, quite common in English and Spanish but not typical. Another concerns the synthesized syllable used. If it really was [bɪ] as transcribed in this paper, this is an unacceptable stressed syllable in English, and in Spanish does not exist at all. The nearest combination of four would be the following: [biβiβiβi]. This could have affected listeners' judgments.

Comparing the rhythms of English and Spanish, Alvarez de Ruf (1978) asked subjects, four native speakers of English and three of Chilean Spanish, to tap rhythmically to recorded "lecture-type style" speech. Her English subjects tapped to the tonic or the stressed syllables (one tapped to every other stress), but of her Spanish subjects, one tapped isochronously but not to the stressed syllables, one tapped sometimes to the stressed syllables while trying to maintain

an isochronous rhythm, but interrupted the regularity over pauses, while the third tapped to the stresses. Non-final interstress intervals ranged from 290-775 milliseconds in Spanish and 290-950 ms. in English (not what one would expect), but there was a much greater difference in the range of vowel duration between the languages, 20-140 ms. in Spanish compared to 20-280 ms. in English. The results of the tapping experiment would seem to indicate that the stressed syllables in Spanish are perceived as regular by some but not by others. It is a pity that more subjects were not used in the experiment. As she found the contoids to vary more in duration than the vowels, she concludes that "it is the contoids that are reduced to keep a fairly isochronous (stress) rhythm" (Alvarez de Ruf, 1978 : 230). It must be remembered however that this is Chilean Spanish whose rhythm is discernibly different from that of other South American varieties (with the possible exception of Argentina) and from peninsular Spanish.

Manrique and Signorini (1983) also concluded from instrumental experimentation that "Spanish has a tendency towards stress-timed rhythm with differentiating characteristics in the way in which this is manifested" (Manrique & Signorini, 1983 : 127). They found the ratio of stressed non-final open syllables to unstressed non-final open syllables to be 1.3:1, considerably wider than other investigators (Delattre, 1966; Olsen, 1972; Pointon, 1980; Dauer, 1983; Hoequist, 1983a). Most of their data was obtained from measurements of a recording of 120 sentences by one Argentinian male and they do not describe their techniques of segmentation. However, Argentinian Spanish does give the subjective impression of being closer to stress-timing than peninsular Spanish and vowel duration seems to be less consistent.

Another type of timing was proposed by Pointon (1978, 1980). He measured mingographic tracings of recordings made by six native speakers of Spanish of the "North Wind and the Sun". He investigated the effect on syllable duration of the type and number of consonants contained in them, classifying consonants into groups according to similarity in their durations. Although Figures 7-16 in his thesis (Pointon, 1978: 150-153) show quite considerable variation in consonant duration according to their structural position, he claims that segments have nearly fixed durations and that the duration of a syllable depends on the sum of its parts while stress is the major external factor having any influence. He therefore discards syllable-timing and stress-timing for Spanish and proposes that Spanish should be placed "in a category of segment-timed languages" while saying "that this implies that in the spoken language no tendency can be discerned towards any rhythmic pattern" (Pointon, 1978 : 95). This seems to be rather a sweeping statement and not exactly consistent with his own results. That a language can exist with no rhythmic patterning is hard to believe, but even if there is evidence of slight manipulation of segment durations, it is surely indicative of something. For a syllable or any other unit, to be purely the sum of its component parts, the realization of these components would have to be equal on each occasion.

Almost all researchers who have measured stress groups in the search for some kind of regular rhythmic repetition in Spanish, have done so either from the beginning of one stressed phonological syllable to the beginning of the following, or vowel onset of the stressed syllable to that of the following. The range has been found to be greater in English in general, but not considerably so, the

majority of the groups falling within the same durational range. Although Spanish is a language with "stressed" syllables which are distinguished from the others both in perception and production, one should not necessarily assume that these stressed syllables perform the same role in Spanish as in English. Dauer suggests that there are many aspects of a language which may contribute towards rhythmic groupings.

> "In all languages we would expect syllables to be grouped into larger units, even if the basis for grouping is something other than a stress beat. Repetitions of particular sounds, syllables, grammatical markers, or pitch patterns, might also be used to group syllables into larger units. If rhythmic grouping takes place in all languages, then the differences summed up by the terms "stress-timed" and "syllable-timed" refer to what goes on within rhythmic groups, the characteristics of successive syllables and their interrelationships, which are ultimately a product of the entire linguistic system" (Dauer, 1983 : 60).

It would fall short of the truth to say that the entire linguistic system has been taken into account in the following chapters, but hopefully parts have been covered which are particularly relevant to the understanding of rhythm in Spanish prose.

CHAPTER II

A SHORT DESCRIPTION OF THE PHONOLOGICAL SYSTEM OF SPANISH AND ITS PRINCIPAL ALLOPHONES

1. Introduction

As this study concerns Spanish phonetics, it was felt necessary to include a short section describing Spanish phonology, the principal allophonic variants and departures from expected realizations which have been observed by the author.

The study of Spanish phonetics and phonology has been at a disadvantage with respect to that of English for various reasons. There has never been what could be called a "school" of Spanish phonetics or phonology and the existing studies have been carried out principally by individuals working on their own, the prime example being Navarro Tomás. This kind of anarchism in scientific investigation is not restricted to the present subject, but extends itself to many disciplines, the reasons for it being very complex. The main one, I believe, is religious, but political, social and economic reasons also combine to play their part. However, it is not within the scope of this study to elaborate on this point. Secondly, although Spanish is spoken as a native language by about 200 million people, the language is certainly not in process of expansion, but rather the opposite, therefore less attention has been paid to it than English. Thirdly, the Royal Academy of the Spanish Language, in establishing what is the "correct" pronunciation of Spanish, has had the effect of not admitting departures from this, or considering them as "vulgarismos" and consequently of restricting or obscuring any awareness or interest in language change or dialectal departures from Castilian Spanish. The fourth reason which is closely connected to the third, concerns the fact that the orthography of Spanish has been thought (and is thought) to represent the pronunciation and indeed it can be said to be

"phonemic" to a much greater extent than English orthography. However, there are notable exceptions, for example, the letters b and v represent indistinctively allophonic variants of the same phoneme, but it is still common practice in many primary schools to teach the pronunciation as if the stop and fricative realizations correspond to b and v in the orthography, thereby differentiating "a ver" (to see) from "haber" (have) when they are both realized as the bilabial approximant.

In general, the work of Navarro Tomás, particularly his book "Manual de Pronunciación Española" (1963) is still considered as the most authoritative study of Spanish phonetics and Alarcos Llorach's book "Fonología Española" (1974) enjoys a similar position with regard to Spanish phonology. Alarcos' analysis is based essentially on Trubetskoy's work in "Principios de Fonología" (1976) (Grundzüge der Phonologie) which is particularly adaptable to Spanish, especially the archiphoneme theory. Alarcos based his binary oppositions on acoustic distinctive features established by Jakobson, Fant and Halle in "Preliminaries to Speech Analysis" (1951). One other major work which should be mentioned is the recently published "Fonética Acústica de la Lengua Española" by Antonio Quilis (1981) which is by far the most comprehensive study to date of acoustic phonetics of Spanish and has examined many dialectal variations as well as peninsular Spanish. The following description of Spanish phonetics and phonology is based mainly on the work of these three authors, Navarro Tomás, Alarcos Llorach and A. Quilis.

2. The Phonemes of Spanish

2.1 Vowels

Table 3 contains the phoneme inventory of Spanish and the relative frequency of occurrence of each one (adapted from Quilis, 1981 : 36). Spanish possesses five vowel phonemes, /i, e, a, o, u/ as illustrated in the following paradigm:

/'pipa/ (pipe) /'popa/ (prow)
/'pepa/ (pip) /'pupa/ (spot)
/'papa/ (Pope)

Although each vowel has several different allophonic realizations, in general they are acoustically and articulatorily quite distinct (with the exception of the approximant realizations of /u/ and /o/ which will be referred to later), and form a neat triangle on a formant chart. Table 4 shows F1 and F2 of stressed vowels in open syllables, read by a female informant and Figure 2, their corresponding positions on a formant chart, adapted from Quilis (1981 : 157, 158). As can be seen, there is relatively little variation in the formant structure of each vowel.

Figure 2

Formant chart of Spanish vowels in Table 3 (Quilis, 1981 : 158)

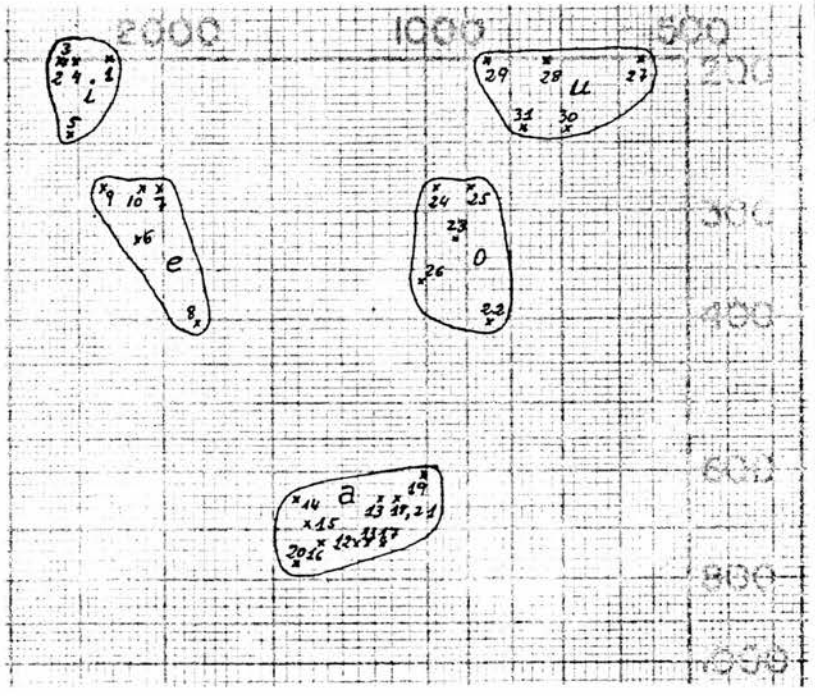


Table 3

Frequency of occurrence of phonemes in Castilian Spanish

(Quilis, 1981 : 36)

	Vowels			Consonants		
Ranking order	Phoneme	Relative frequency of occurrence	Information quantity	Phoneme	Relative frequency of occurrence	Information quantity
1	e	14.67	0.4062	s	8.32	0.2984
2	a	12.19	0.3701	N	4.86	0.2120
3	o	9.98	0.3318	t	4.53	0.2022
4	i	7.38	0.2775	d	4.24	0.1933
5	u	3.33	0.1634	l	4.23	0.1930
6				k	3.98	0.1851
7				r	3.26	0.1610
8				m	3.06	0.1539
9				n	2.78	0.1436
10				p	2.77	0.1433
11				b	2.37	0.1279
12				R	1.93	0.1099
13				θ	1.45	0.0885
14				g	0.94	0.0633
15				x	0.57	0.0425
16				f	0.55	0.0413
17				rr	0.43	0.0338
18				j	0.41	0.0325
19				λ	0.38	0.0306
20				tʃ	0.37	0.0299
21				D	0.31	0.0258
22				G	0.28	0.0237
23				ɲ	0.25	0.0216
24				B	0.03	0.0035
	Total	47.55		Total	52.30	

Archiphonemes as a result of neutralization:

/p,b,f/→/B/, /k,g,x/→/G/, /t,d,θ/→/D/

/n,m,ɲ/→/N/, /rr,r/→/R/.

Table 4

Formants of Spanish vowels (Quilis, 1981 : 157, 158)

		F1 Hz	F2 Hz
/i/	1 ['biβo] vivo (I live)	202	2,308
	2 [a'ki] aqui (here)	202	2,632
	3 [amaˈriʎos] amarillos (yellow)	202	2,592
	4 ['dia] dia (day)	202	2,511
	5 [θeˈriʎas] cerillas (matches)	243	2,551
/e/	6 [be'βe] bebe (baby)	324	2,146
	7 [θerˈβeθa] cerveza (beer)	283	2,025
	8 ['perro] perro (dog)	405	1,822
	9 ['neɣras] negras (black)	283	2,349
	10 ['treθe] trece (thirteen)	283	2,106
/a/	11 ['baβa] baba (saliva)	729	1,174
	12 [apa'rato] aparato (aparatus)	729	1,215
	13 ['kaβa] cava (box, crate)	648	1,134
	14 ['kaδa] cada (each)	648	1,417
	15 ['kaθa] caza (game, hunt)	688	1,377
	16 ['gafas] gafas (glasses)	729	1,336
	17 ['pasas] pasas (raisins)	729	1,134
	18 ['rrama] rama (branch)	648	1,093
	19 ['parra] parra (grape-vine)	607	1,012
	20 ['tatʃa] tacha (stain)	769	1,417
	21 ['baja] vaya (go - subj.)	648	1,093
/o/	22 ['boβo] bobo (stupid)	405	850
	23 ['dʒo] yo (I)	324	931
	24 ['toδo] todo (all)	283	972
	25 ['otʃo] ocho (eight)	283	891
	26 ['doθe] doce (twelve)	364	1,012
/u/	27 [beinti'uno] veintiuno (twenty-one)	202	567
	28 [bir'tuδ] virtud (virtue)	202	729
	29 [sepul'tura] sepultura (burial)	202	850
	30 ['pupas] pupas (spots, little wounds)	243	688
	31 ['rruso] ruso (Russian)	243	769

Figures 3-7
Acoustic and articulatory realizations of Spanish vowels
(Quilis, 1981 : 172-174)

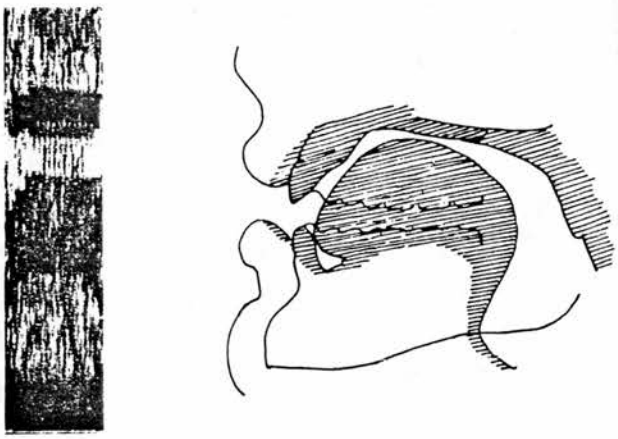


Fig. 3 /i/ in ['βiβo] (I live).

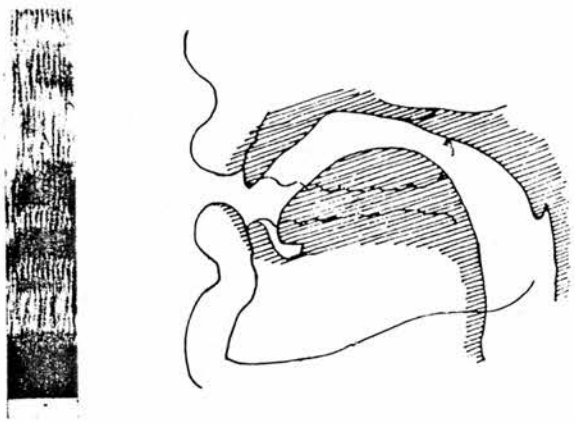


Fig. 4 /e/ in ['βeβe] (he/she drinks)

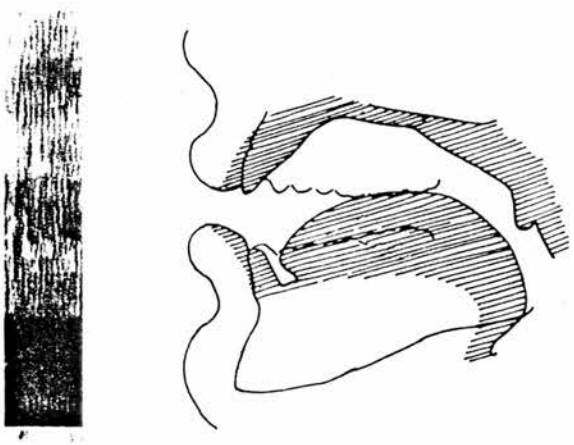


Fig. 5 /a/ in ['βaβa] (saliva).

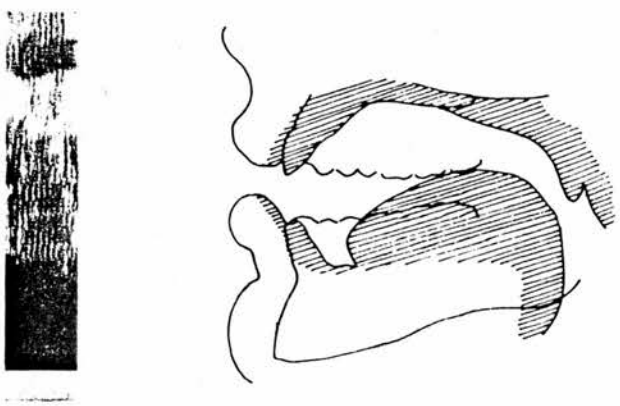


Fig. 6 /o/ in ['βoβo] (idiot).

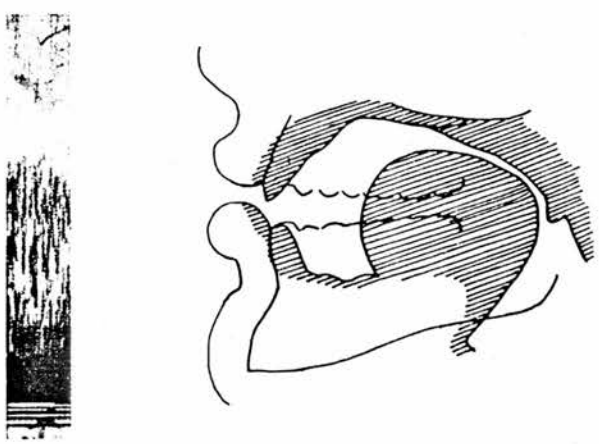


Fig. 7 /u/ in ['pupas] (spots, little wounds).

Figures 3-7, also adapted from Quilis (1981 : 172-174) show the articulatory and acoustic aspects of the five vowel phonemes in "normal" phonetic position and in stressed syllables. Quilis defines as normal their occurrence between labial consonants where tongue position for the consonants should not affect the vowel. The words containing the vowels were situated within frame sentences and read by a speaker of Castilian Spanish. The articulatory diagrams were obtained from X-ray films and correspond to the "moment of maximum articulatory tension".

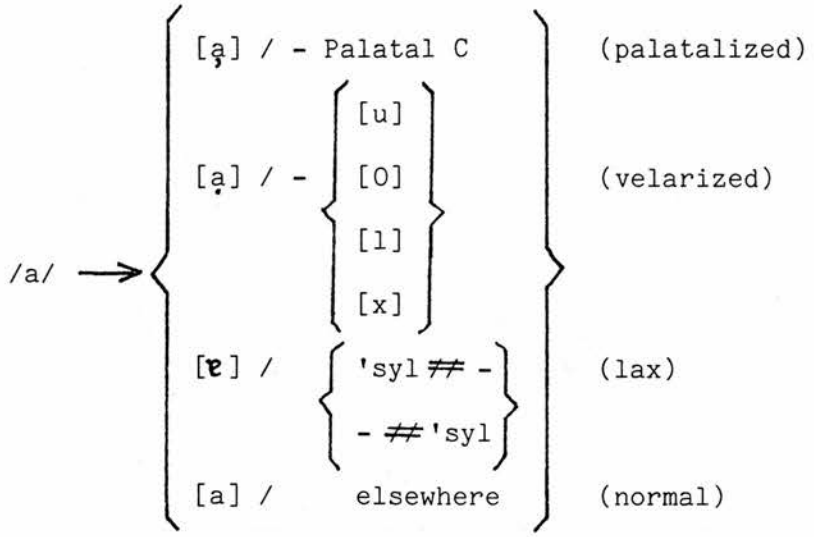
In addition to the following allophones for each vowel, all vowels can be nasalized when between nasals or when preceded by a nasal consonant, and also open when occurring as 1st member of a falling diphthong.

2.1.1 /a/

The vowel /a/ is open and occupies a mid-position between cardinal vowels [a] and [α]. It is described in the following articulatory terms by Navarro Tomás:

> "/a/...requires greater lip opening than that of the other vowels; jaw opening about 10 mm between the incisors, the tongue gently extended within the lower jaw, touching the lower molars with its sides, its surface raised slightly towards the mid part of the mouth, the tongue tip touching the lower incisors but slightly below the upper edge, the place of articulation being determined by the slight raising of the surface of the tongue towards the point where hard and soft palate join." (Navarro Tomás, 1963 : 55).

Navarro Tomás distinguishes three variants of /a/ in addition to the normal realization described above, which are in complementary distribution.



Examples: [ạ] cacho ['kạtʃo] (horn), calle ['kạλe], (street), cañ̃a ['kaɲa] (cane), cayo ['kajo] (little island).

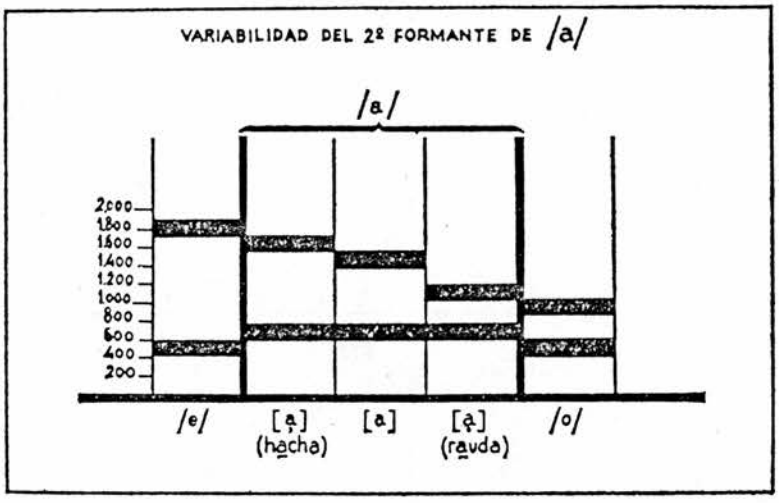
[ạ] causa ['kạu̯sa] (cause), Bilbao [bil'βạo], ạldea [ạl'dea] (village), ạjo ['axo] (garlic).

[ɐ] camarada [kamɐ'raδɛ] (comrade).

[a] parte ['parte] (part).

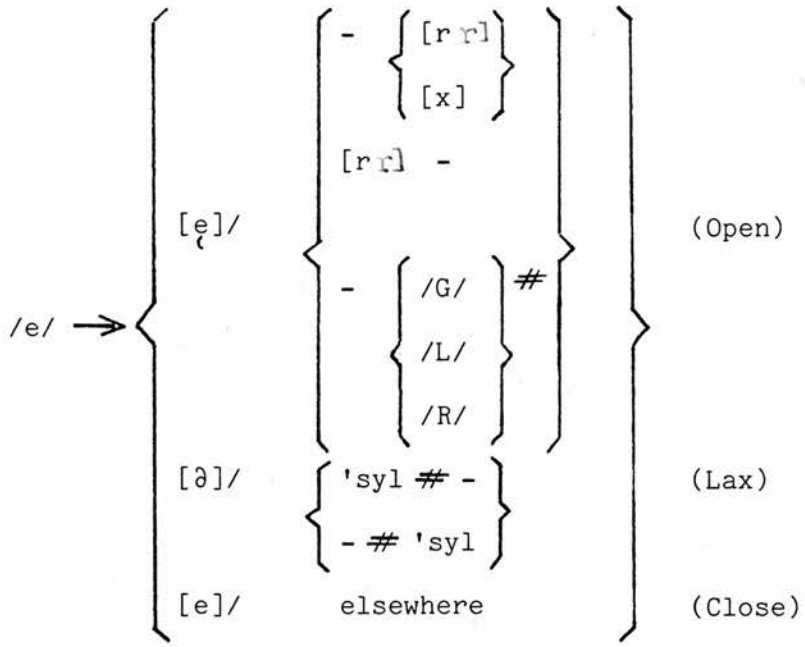
It has been pointed out to the author that this lax variety of /a/ (i.e. centralized) is much more noticeable in post-stressed position within the word than in pre-stressed, although the difference is still very small. Alarcos tested the palatalized and velarized variants of /a/ and found that they differed considerably in the second formant (see Fig. 8, Alarcos Llorach, 1974 : 148) although comparing the palatalized [a] of "acha" (axe) in Alarcos' diagram with N° 20 of Quilis data (Table 3), the second formant in the former (F2 = 1,650 Hz) is considerably higher than in the latter (F2 = 1,417 Hz).

Figure 8
Variability of the second formant of the Spanish vowel /a/
(after Alarcos Llorach, 1974 : 148)



2.1.2 /e/

The vowel /e/ is a front half-close vowel but with considerable difference between its close and open realizations. For the close variety "the tip of the tongue rests against the lower incisors, the front is raised towards the hard palate, the sides are touching the molars up to approximately the middle of the second molar, the opening between the tongue and the hard palate and between the lips is greater than for /i/ and the opening between incisors is about 6 mm" (Navarro Tomás, 1963 : 51). The articulation of the open /e/ "presents greater jaw opening, about 8 mm, contact of the tip of the tongue with the lower incisors is softer and the place of articulation slightly further back than in the close variety" (op. cit.: 52). Three varieties of /e/ are distinguished:



Examples: [ę] papel [papęl] (paper), exhausto [ęɣ'saũsto](exhausted), pérdida [pęr'δiδa] (lost).

[ə] húmedo ['uməδo] (damp), pelea [pə'lea] (fight).

[e] té ['te] (tea), vengo ['beŋgo] (I came), étnico ['eδniko] (ethnic), este ['este] (east), desde ['dezδe] (since).

The symbol [ə], commonly used for the centralized or lax realization of /e/, is somewhat misleading. The Spanish vowel never approximates to a schwa, even in word final post-stressed position. The phonetic distinction between [e] and [ę] is apparent in some contexts and not in others. There is certainly a noticeable difference between [e] in "pero" (but) and [ę] in "perro" (dog), the first being close to cardinal 2 and the second close to cardinal 3, but when native speakers were asked if there was a difference between /e/ in "tres" (three) and /e/ in "té" (tea), the answer was affirmative. /e/ in "té" is perceived as being closer than in "tres", but when "te" is pluraled, the quality is felt to be the same.

2.1.3 /i/

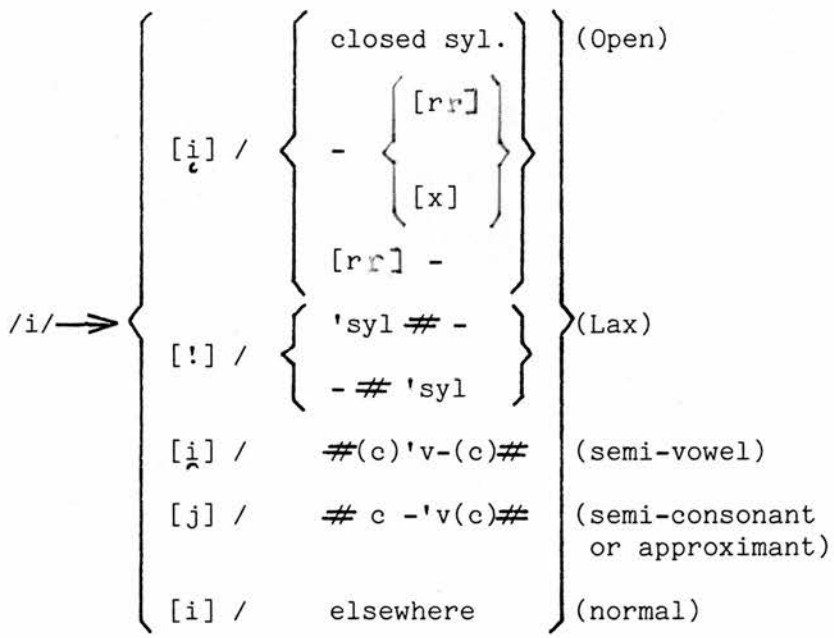
For the close realization of /i/,

> "the tip of the tongue is touching the lower incisors, the front is raised towards the hard palate, touching it at the sides, and leaving a relatively narrow opening: contact is made between tongue and teeth up to the front of the canine teeth. The jaw opening is about 4 mm between the incisors, lips are spread, the corners pulled slightly back."

In the open realization,

> "the place of articulation is not so far forward towards the alveolar ridge and the opening is somewhat greater between the tongue and the palate." (Navarro Tomás, 1963 : 46, 47).

Five allophones of /i/ are distinguished:



Examples: [i̝] rico ['rri̝ko] (rich), hijo ['i̝xo] (son),

sentir [sen'ti̝r] (feel).

[!] timido ['tim!ðo] (shy), pan y vino ['pan!'βino]

(bread and wine).

[i̯] baile ['bai̯le] (dance), rei̯na['rrei̯na] (queen),

soy ['soi̯] (I am), muy ['mui̯] (very).

[j] piedra ['pjeðra] (stone).

[i] libro ['liβro] (book).

The difference between the open and close realizations of /i/ is not nearly so noticeable as between the corresponding allophones of /e/ and /o/ and the difference between the more peripheral and the lax varieties is barely distinguishable. Navarro Tomás does say that the latter distinction disappears in careful speech (Navarro Tomás, 1963 : 48). The realizations of /i/ as what is usually termed semi-vowel and semi-consonant in falling and rising diphthongs respectively, has been investigated acoustically by Quilis. Figs. 9 and 10 reproduce his spectrograms (Quilis, 1981 : 180). The smooth formant transitions can be observed in hacia ['aθja] (towards), compared to the stability of the separate vowels in "hacia" [a'θia] (he did) which form two syllables and are much longer. Similarly in "vaina" ['baina] (sheath), the formant transitions are smoother than in "raiz" [ra'iθ] (root) where the vowel /i/ is much more stable and again longer.

2.1.4 /o/

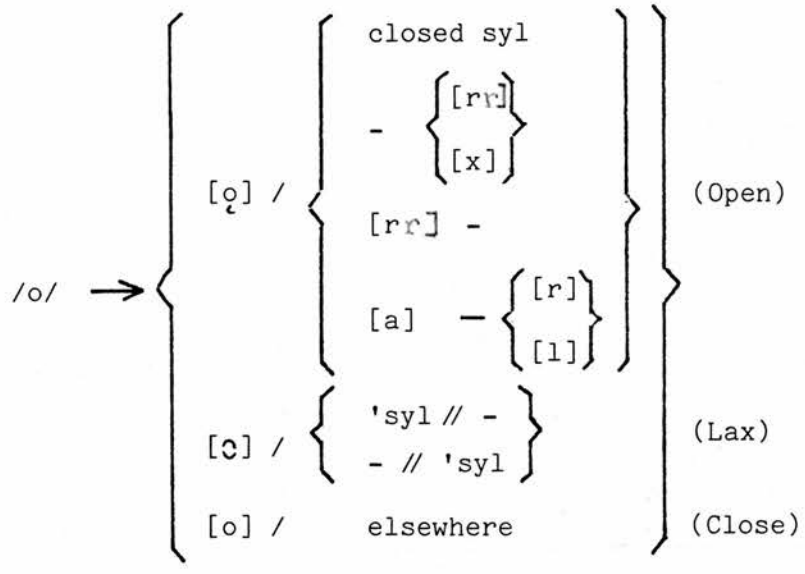
In the close variety,

> "lips are protruded and rounded, giving an oval form; opening between jaws, about 6 mm between incisors; the tongue is bunched towards the back of the mouth, the back being raised towards the velum, the tip of the tongue touching the gum below the lower incisors."

In the open variety,

> "lip-opening is greater than in the close, jaw separation about 8 mm between incisors, the tongue is raised slightly less towards the velum" (Navarro Tomás, 1963 : 57,59).

Three realizations of /o/ are distinguished:



Examples: [o̜] donde ['do̜nde] (where), zorro ['θo̜rro] (fox),
ojo ['o̜xo] (eye), ahora [a'o̜ra] (now),
la ola [la'o̜la] (the wave).

[ɔ] castigo [kas'tiɣɔ] (punishment).

[o] pollo ['poʎo] (chicken).

The difference between the open and close realizations of /o/ is much more noticeable than /i/ or /u/. It reaches phonemic status sometimes in Spain, particularly East Andalusia and parts of South America where syllable final /s/ is often elided. Word recognition can therefore depend on whether /o/ is open or close, for example "Dios" (God) will be heard frequently as ['djo̜] with only the vowel distinguishing it from "dio" (he gave), although these words would be unlikely to occur ambiguously, but often vowel quality distinguishes singulars from plurals, for example:

"libro" [liβro], "libros" [liβro̜] (book(s)),

alguno [alɣuno], algunos [alɣuno̜] (one of them, some).

Figures 9-12
Spectrograms of the Spanish vowels /i/ and /u/ in diphthongs and hiatus (Quilis, 1981 : 180,182).

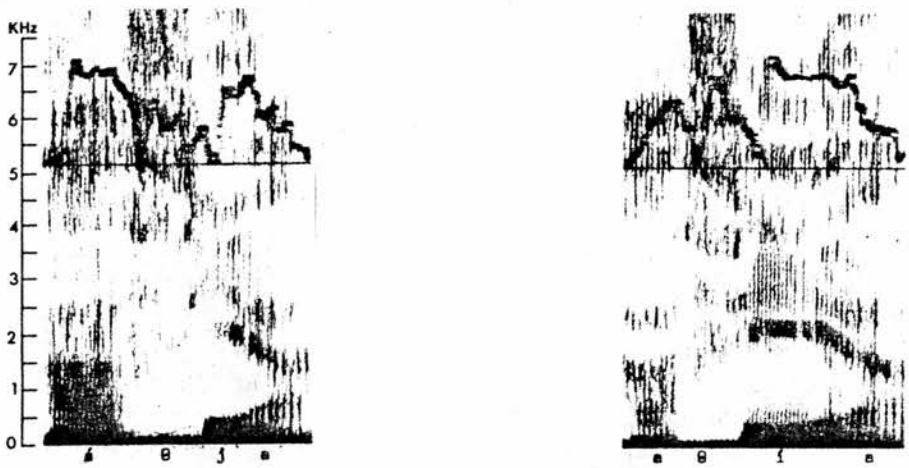


Fig. 9 hacia ['aθja] hacía [a'θia]
Reduced spectrogram of diphthong [ja] - hiatus ['ia]

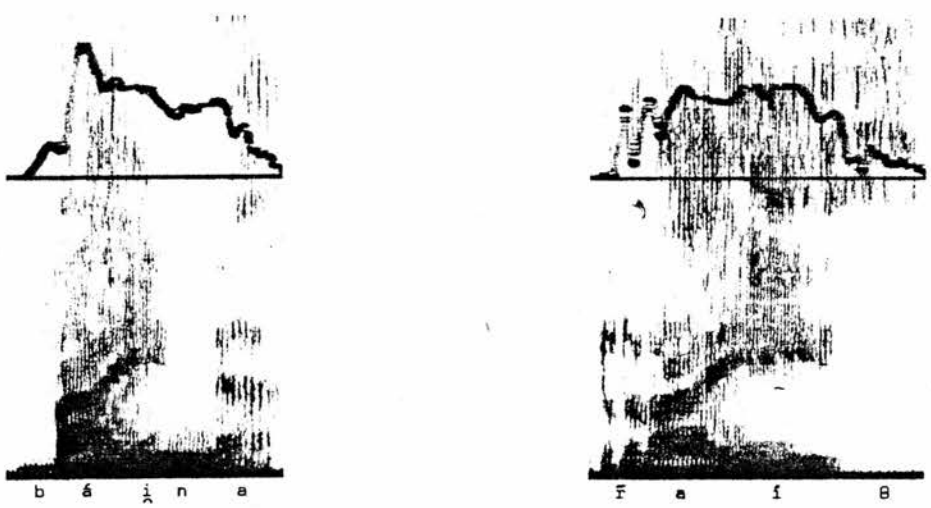


Fig. 10 vaina ['baina] raiz [r ra'iθ]
Reduced spectrogram of diphthong ['ai] - hiatus [a'i]

Spectrograms of the Spanish vowels /i/ and /u/ in diphthongs and hiatus (Quilis, 1981 : 180, 182) continued.

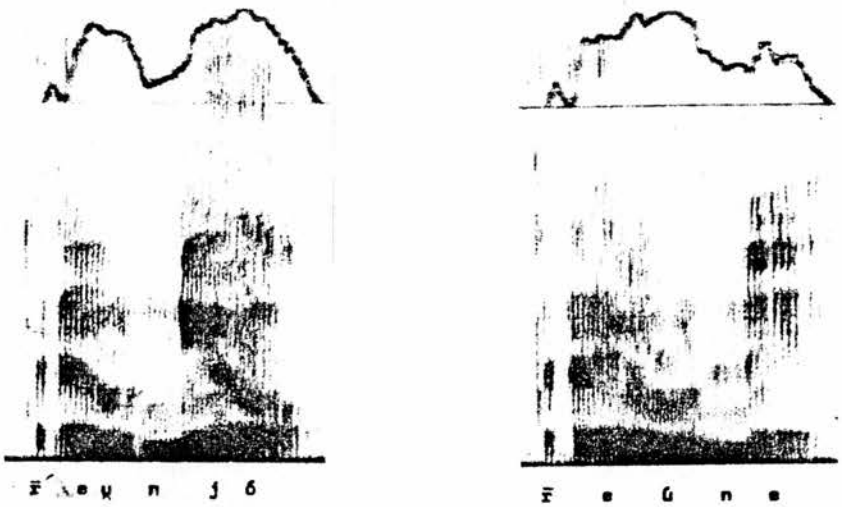


Fig. 11 reunio [rreu'njo] reune [rre'une]
Reduced spectrogram of diphthong [eu] - hiatus [e'u]

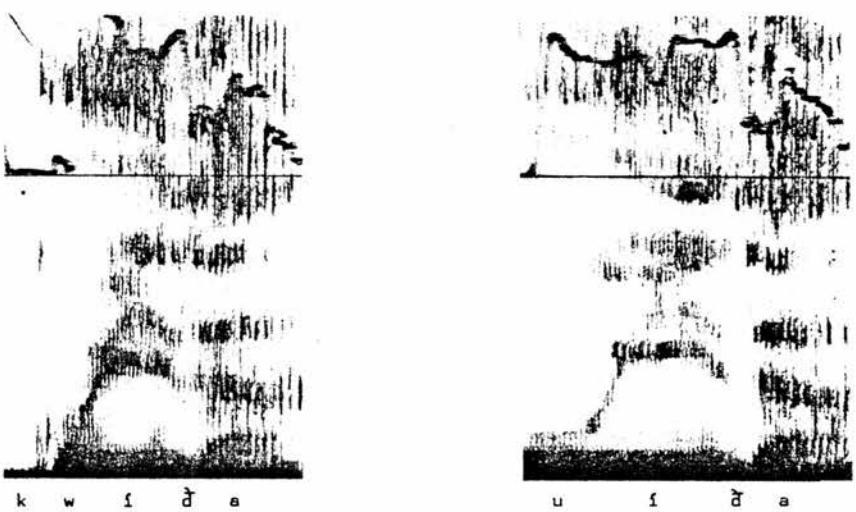


Fig. 12 cuida ['kwiða] huida [u'iða]
Reduced spectrogram of diphthong [wi] - hiatus [u'i]

2.1.5 /u/

> "Lips are more protruded and rounded than for /o/ and form a small oval; jaw separation, about 4 mm between the incisors; the tongue bunched towards the back of the mouth and the back raised higher than for /o/ towards the velum; the tip behind the lower incisors and almost suspended in the hollow of the lower jaw" (Navarro Tomás, 1963 : 61).

The open /u/ is described as having less lip rounding and the highest part of the tongue slightly lower although Navarro Tomas does say that the difference between the two sounds is relatively small.

Five allophones of /u/ are distinguished:

/u/ →

[u̟]	/ closed syl - {[rr̝], [x]}; [rr̝] -	(Open)
[ʉ]	/ 'syl## -; - ##'syl	(Lax)
[u̯]	/ ##(c)'v-(c)##	(semi-vowel)
[w]	/ ## c-'v(c)##	(semi-consonant)
[u]	/ elsewhere	(close)

Examples: [u̟] burro ['bu̟rro](donkey), turba ['tu̟rβa] (peat), empuja [em'pu̟xa] (push).

[ʉ] cinturón [θintʉ'ron] (belt).

[u̯] causa ['kau̯sa] (cause), deuda ['deu̯ða] (debt).

[w] caundo ['kwando] (when), fuerza ['fwerθa] (strength).

[u] pupa ['pupa] (spot).

As with /i/, the open and lax varieties of /u/ are hardly distinguishable and may not be present in careful speech. Quilis' spectrograms are reproduced in Figures 11 and 12 to show the acoustic differences between /u/ in falling and rising diphthongs and when forming a

separate syllable from the adjacent vowel. Again the smooth formant transitions can be observed in [rreu̯njo] (he met) where [eu̯] forms a falling diphthong compared to the more stable formants of [e'u] in [rre'une] (he meets) where the vowels are nuclei of separate syllables. In Figure 12 the differences can be observed between [w] in the rising diphthong in['kwiδa] (he takes care of) compared to [u] in [u'iδa] (escape) where F2 maintains a steady state (although the informant must have pronounced "huida" very slowly and distinctly).

2.1.6 Diphthongs

According to Alarcos, Spanish has six falling diphthongs [ai̯, au̯, ei̯, eu̯, oi̯, ou̯] and eight rising [ja, je, jo, ju, wa, we, wo, wi], for example in "aire" ['ai̯re] (air), "causa" ['kau̯sa] (cause), "seis" ['sei̯s] (six), "reuma" ['rreu̯ma] (rheumatism), "sois" ['soi̯s] (you are), "hacia" ['aθja] (towards), "tierra" ['tjerra] (land), "adios" [a'δjos] (good-bye), "viuda" ['bjuδa] (widow), "cuarto" ['kwarto] (room), "cuerda" ['kwerδa] (string), "cuita" ['kwita] (sorrow), "menguo" [meŋ'gwo] (it reduced) (Alarcos, 1974 : 150-151); [ou̯] only occurs across word boundaries.

Alarcos states that these diphthongs are bi-phonematic, basing his arguments on Trubetskoy's rules for determining the monophonematic nature of successive sounds. The first states that in order for two sounds to be monophonematic, they should not be able to form part of two different syllables (Trubetskoy, 1976: 49) . Spanish diphthongs are very unstable in this respect. According to Alarcos, the elements of the three diphthongs [ai̯, ei̯, oi̯] can be separated under certain conditions and are therefore diphonematic e.g. "ay" but "a-yes" (Oh, Ohs), "rey" but "re-yes" (king, kings),

"hoy" but "ho-yes" (today, today is). Also, two adjacent vowels often form diphthongs across word boundaries e.g. in "compre una casa" (I bought a house), the combination of /e/ and /u/ is realized as [e̯u̯], in "cinco y media" (half past five), /o/ and /i/ are realized as [o̯i̯] (although probably more often as [wi], ['θiŋkwi'meðja]) and similarly in "callan y escuchan" (be quiet and listen), /i/ and /e/ combine to form [je]. (The author feels that the realization of /i/ and /e/ is more often [i̯e] than [je] under these conditions.) According to the sixth rule of Trubetskoy (Trubetskoy, 1976 : 53) a combination of potentially monophonematic sounds can only be considered as such when one of those sounds cannot be considered an allophone of any other phoneme. Obviously [a, a̟, e̞, e, o̞, o, u, i] are realizations of the vowel phonemes because they are not interchangeable, for example [a] for [a̟] or [e̞] for [e]. The combinatory sounds [j, i̯, w, u̯] are also in complementary distribution as [j] and [w] only occur as first elements of combinatory sequences of vowels, [i̯] and [u̯] only occur as final elements and [i] and [u] always function as syllable nuclei. What's more, similar sounds such as [ji], [wu] cannot occur adjacently[1] (which of course they do in English in words such as "yeast", wooed"), therefore Alarcos concludes that they are no more than allophonic variants of /i/ and /u/ respectively and consequently that all the diphthongs are combinations of two phonemes (Alarcos, 1974 : 150-153).

Although Alarcos and Navarro Tomás do not include /oa/ and /eo/ as combinatory elements of diphthongs, they are commonly realized as such, for example [to'aʎa] (towel) realized as ['twaʎa] and [kampe'on] (champion) realized as [kam'pjon]. The combination of /o/ and /a/ forming [wa] is very common in all parts of the

(1) This is not altogether true: the diminutive ending [ita] can be added to words such as "raya" (ray) giving [ra'jita], "hoyo" (hole), giving [o'jito]. However, they are never found adjacently in the same morpheme.

Spanish-speaking world. /e/ and /o/ realized as [jo] is rather less common in Spain but widely spread in South America. In these cases, the opposition between the phonemes /o/ and /u/, and /i/ and /e/ respectively, is neutralized.

2.2 Consonants

Castilian Spanish distinguishes nineteen consonant phonemes /p, b, t, d, k, g, ʧ, f, θ, s, x, j, m, n, ɲ, l, λ, rr, r/ as illustrated in the following paradigms:

/rropa/(clothes)	/ata/ (he ties)	/kajo/ (island)	/gato/ (cat)
/rroba/(he steals)	/ada/ (fairy)	/kaɲo/ (tube)	/gafo/ (idiot)
/rrota/(broken)	/aga/ (do - subj.)	/kalo/ (I drill)	/gano/ (I win)
/rroka/(rock)	/aʧa/ (axe)	/kaλo/ (corn on foot)	
/rroθa/(it touches)	/ama/ (he loves)	/karo/ (expensive)	
/rrosa/(rose)		/karro/(car, cart)	
/rroxa/(red)			

Archiphonemes are included in Table 3 (p.45) and are dealt with in the corresponding sections for their constituent phonemes.

The phonemes are classified and described conventionally according to degree of stricture and place of articulation.

2.2.1 Oral Stops

Spanish has six oral stops:

	Voiceless	Voiced
Labial	/p/ → [p]	/b/ → { [b] / { utterance ##-, nasal C -, elsewhere } ; [β] }

Examples: papel [pa'pel] (paper), bebo ['beβo] (I drink), ambos ['ambos] (both).

Dental	/t/ → [t]	/d/ → { [d] / { utterance ##-, nasal C -, lateral C - } ; [ð] elsewhere }

Examples: torta ['torta] (cake), dedo ['deðo] (finger), cuando ['kwando] (when), caldo ['kaldo] (soup, stock).

	Voiceless	Voiced
Velar	/k/ → [k]	/g/ → { [g]/ {utterance #-, nasal C -} ; [γ]/ elsewhere }

Examples: ganga ['gaŋga] (bargain), algo ['alγo] (something).

Although the allophones [β, δ, γ] are classed as fricatives by Spanish phoneticians, there is very little audible friction in their production, if any, and should be more appropriately termed approximants. In fact, in many verb endings, particularly "ado", the consonantal element is elided and the two vowels form one syllable, e.g. "hablado" [a'βlao] (spoken). The word "pescado" (fish, that which has been fished) is frequently written incorrectly "pescao" and if it is pronounced [pes'kaδo] sounds stilted or affected. When the ending is "ido", although [δ] is often elided, the vowels remain in hiatus, e.g. "decidido" [deθiδio] (decided). [β] and [γ] are more stable. The symbols [β, δ,γ] are used to indicate either approximant or fricative realizations.

All phonemes are in opposition in syllable initial position but syllable finally, the opposition is neutralized between p/b, t/d, and k/g respectively, resulting in the archiphonemes /B, D, G/. (See also section 2.2.4, Fricatives.) The usual realization in this position is the voiced approximant, but in slow, careful speech, the voiceless stop may occur. Examples: "apto" ['aβto] (apt), "excelente" [eγse'lente] (excellent), "adquirir" [aδki'rir] (acquire). The voicing of the arresting consonant may also however have the effect of voicing the following releasing consonant, e.g. "absolutamente" [aβzo'luδa'menδe]. (Produced by DP: Noah's Ark, Appendix 6.) Quilis gives an example of the possible realizations of /G/ in "doctor" [dok'tor > dog'tor > doγ'tor > dou'tor > do'tor] (Quilis, 1981 : 191).

2.2.2 Nasal Stops

Spanish has three nasal phonemes:

Labial /m/ → [m]

Alveolar /n/ → [n]

Palatal /ɲ/ → [ɲ]

Examples: cama ['kama] (bed), cana ['kana] (white hair), caña ['kaɲa] (cane).

They are only realized as such in syllable initial position. Syllable finally, the opposition is neutralized, resulting in the archiphoneme /N/. This has many possible realizations depending entirely on the place of articulation of the following consonant:

/N/ → [m] / - labial C
[ɱ] / - labio-dental C
[n̟] / - interdental C
[n̻] / - dental C
[n] / - alveolar C
[ɲ] / - palatal C
[ŋ] / - velar C

Examples: cambio ['kambjo] (change), enfático [eɱ'fatiko] (emphatic), encías [en̟'θias] (gums), entre ['entre] (between), enlace [en'laθe] (joining), cancha ['kaɲtʃa] ((tennis) court), vengo ['beŋgo] (I come).

2.2.3 Affricates

Spanish has only one affricate phoneme:

Alveolo-palatal /tʃ/ → [tʃ]

Example: muchacho [mu'tʃatʃo] (boy)

This phoneme is always realized as [tʃ] and only occurs in syllable-initial position.

2.2.4 Fricatives

Castilian Spanish distinguishes five fricatives:

Voiceless

Labio-dental /f/ → [f]

Dental /θ/ → [θ]

Apico-alveolar /s/ →
- [z] / - voiced C, except dental
- [s̪] / - voiceless dental C
- [z̪] / - voiced dental C
- [s] / - elsewhere

Velar /x/ → [x]

Voiced

Palatal /j/ →
- [dʒ] / utterance # -
- [dʒ] / nasal C -
- [dʒ] / lateral C -
- [j] / elsewhere

Examples: fuerza ['fwerθa] (strength), mismo ['mizmo] (same), este ['es̪te] (this), desde [dez̪δe] (since), soso ['soso] (insipid), yo [dʒo] (i), cónjuge ['kondʒuɣe] (spouse), el yunque [eʎ'dʒuŋke] (the anvil), mayo ['majo] (may), ajo ['axo] (garlic).

Alarcos Llorach considers the opposition between /f, p, b/ to be neutralized in syllable-final position, thus forming the archiphoneme /B/ (Alarcos, 1974 : 171). Actually the letter 'f' appears in very few words and only of foreign origin, e.g. afgano [aβ'ɣano] (Afg̊an), difteria [diβ'terja] (diphtheria). The opposition between /θ, t, d/ is also neutralized in syllable-final position, forming the archiphoneme /D/ which may be realized as [θ, d, δ, ð̞, t] but usually [ð̞], e.g. "hazte" ['að̞te] (make yourself).

The realization of /s/ is very varied in different parts of the Spanish-speaking world and in many places the opposition /s//θ/ hasbeen lost (or never existed in the first place), the realization being

either [s] (apico-alveolar or alveolar) or [θ] in all cases. In parts of Andalucia and South America, [s] and [h] are in complementary distribution, [s] occurring syllable-initially and [h], syllable-finally.

/x/ only occurs in syllable-initial position except in one word "reloj" (watch, clock) which is usually realized as [re'lo] but the /o/ is noticeably the open allophone. The opposition between /x, k, g/ is neutralized in syllable-final position. /x/ (if present) is realized as [γ] in a phrase such as "el reloj de Juan" (John's watch).

Although /j/ is classed as a fricative by Spanish phoneticians, its realization is usually approximant [j̞]. (An Argentinian speaker is immediately identifiable by his fricativization of /j/.)

2.2.5 Lateral Approximants

Castilian Spanish has two lateral phonemes:

Alveolar /l/ → [l]

Palatal /λ/ → [λ]

Example: mala ['mala] (bad), malla ['maλa] (wire-netting).

The opposition between these two phonemes is neutralized syllable-finally, forming the archiphoneme /L/ with the following distribution:

/L/ → [λ] / - palatal C
[l̪] / - dental C
[l] / - elsewhere

Examples: colchon [koλ'tʃon] (matress), calzado [kal̪θaδo] (footwear), calma ['kalma] (calm).

The distinction between /ʎ/ and /j/ is maintained in Castile, but the use of [j] for [ʎ] is now widespread in other parts, so the distinction is lost in a minimal pair such as "calló" (he became quiet) and "cayó" (he fell).

2.2.6 Intermittent Closure

Spanish has two phonemes:

Apico-alveolar

/r/ → [r]

/rr/ → [rr]

Examples: carro [karro] (car, cart), caro [karo] (expensive).

These two phonemes are only in opposition between vowels and, word-medially. Word-initially and finally and syllable-finally, the opposition is neutralized forming the archiphoneme /R/. This is realized word-initially as [rr] and after /N/ and /L/ and /S/, e.g. rico['rriko](rich), honrado[on'rraδo](honest), alrededor[alrreδe'δor] (around), Israel [izrra'el]. Word-finally, the realization is [r] or [r̥] but occasionally [rr] in emphatic or declamatory speech, e.g. comer [komer̥] (to eat), Mi amor! [mja'morr](My love!). [r] is invariably one tap and [rr]two, three or maybe even more. [rr] has the effect of opening the preceding vowel to such an extent that word recognition often depends more on the openness of the vowel than the number of taps. An open /e/ plus fricative [ɹ] in/perro/, will be interpreted correctly as "dog". This is not the case only when the preceding vowel is /a/ as in the above example.

2.3 Examples of phonetic and phonemic transcription

It can be seen from the above brief summary of Spanish phonemes and their allophonic variants, that there are well-established explicit rules for Spanish allophones, based on Castilian Spanish

and allowing for very little dialectal or ideolectal variation, if any. Wherever Spanish phonetics is taught, be it in Spain or South America, these rules are invariably followed and phonetic transcriptions have to be done accordingly. This conservative attitude stems, I believe, from the reasons mentioned in the introduction to this chapter and even recent research is based on an acceptance of the rules. Below is a short example of the type of phonetic and phonemic transcription resulting from the above description.

La Palabra (The Word)

Orthography

Asi pues, yo creo que la palabra es la maravilla mayor del mundo, porque en ella se abrazan y confundan toda la maravilla corporal y toda la maravilla espiritual de nuestra naturaleza.

Phonetic

[a'si 'pwes ^ dʒo 'kreo kð lɛ pa'laβrɐ ez lɛ marɐ'βilɐ mɐ'jo̰r ðel 'mu̱ndo ^ porke ðn 'elɐ se ɐ'βraθan ! ko̰ŋ'fu̱ndɐn̰'toðɐ lɐ marɐ'βilɐ ko̰rpo̰ral ! 'toðɐ lɛ marɐ'βilɐ espiritu'al̰ dð 'nwestrɐ naturɐ'leθɐ].

Phonemic

/a'si 'pues ^ jo 'kReo ke la pa'labRa es la mara'bila ma'joR deL 'muNdo ^ poRke eN 'ela se a'bRaθaN i koN'fuNdaN 'toda la mara'bila koRpo'raL i 'toda la mara'bila espiritu'aL de 'nuestRa natura'leθa/.

3. Problematic areas of Spanish phonology

3.1 Voiced Stops

Alarcos accepts as the principal member of these phonemes, the stops [b, d, g] which are supposed to occur utterance initially, following nasals, and [d] following laterals also. In the data of Noah's Ark (for Chapter VI) read by five different native speakers

(Appendix 6), the realizations of these phonemes in the above contexts were not usually stops. Of two occurrences of /Nb/ in the text, none of the realizations of /b/ were stops, of fourteen occurrences of /Nd/ and one of /Ld/, LR produced six stops, AS three, JG five, JF four, and DP none. Of eight occurrences of /Ng/ and one of /#g/, LR produced eight stops, AS five, JG six, JF one, and DP one. The realizations of all these phonemes as stops correlates positively with the age of the informants but a lot more data would need to be examined before this could be tested statistically. Whether stops occur or not may also be connected to speech rate as DP was the fastest speaker. However, the majority of the realizations did not involve complete closure and were therefore fricatives or approximants. If the principal member of the phoneme (or underlying form for the generativists) is the stop, what criteria is this based on? It can certainly not be frequency of occurrence. Even without considering the approximant (or fricative) realizations of /b, d, g/ just referred to, [β, δ, γ] occur far more frequently in connected speech than [b, d, g]. If one considers the "strong" position in the word, strong meaning the place at which the greatest number of phonemes can commute, it is intervocalic, word-medial (not word-initial) and the realization here is of course [β, δ, γ] again. (See Syllable Structure, Section 4). In favour of [b, d, g] as the underlying form, is the fact that the alphabetic representation of the sounds is only shared between the letters "b" and "v" in the case of /b/, [d] and [δ] are both "d" (although the archiphoneme D may be represented by "d, t, z") and [g] and [γ] are both "g". Also in citation form the stops are usually produced, but only in utterance-initial position and after nasals, and after/L/ in the case of /d/. It has

never been suggested however, that the stops in these contexts may be intrusive. They are very short where they do occur and intrusive stops in these contexts are quite common. In English one can think of many examples, [mints] for [mins] (mince), [wʌnts] for [wʌns], [ɒn'dδɛð] for [ɒn'δɛð] (on there), ['dδɛðjɷ'α] for ['δɛðjɷ'α] (there you are). The feature which is accepted as distinguishing /b, d, g/ from /p, t, k/ in Spanish is presence or absence of vocal cord vibration, so degree of stricture is, in a sense, irrelevant. However, there are many examples of voiced /p, t, k/ in the Noah's Ark data although there does seem to be a diminution of voicing compared to /b, d, g/. The most favourable position for voiceless segments is initial of stressed syllables. To establish whether degree of stricture plays its part in correct identification of the voiced set from the voiceless would require further research. However, it is certainly preferable, at least for language teaching purposes, to consider [b, d, g] as exceptions to the rule rather than vice-versa.

3.2 /j/

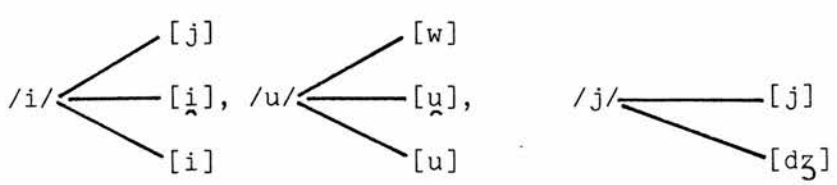
In connection with the above, the phoneme /j/ also presents a problem. It correlates with /b, d, g/ in that the stop allophone [dʒ] is also supposed to occur in utterance-initial position and following homorganic nasals or laterals. The feature distinguishing it from /tʃ/ is presence of voicing. It would seem more consistent to consider all these phonemes as /b, d, g, dʒ/ or /β, δ, γ, j/. Probably the original reason for symbolizing the phonemes /b, d, g, j/ was that the alphabetic symbols which represent most of their allophones are "b, d, g, y", in fact in many Spanish books on the subject /y/ is used for the phonemic symbol and [y] also for the fricative

variant. Alarcos also points out that /j/ does not behave in exactly the same way as /b, d, g/. The opposition between these phonemes and the corresponding voiceless stops and fricatives is neutralized in post-nuclear position whereas the only alveolar/palatal oral phoneme occurring in this position is /s/, so no neutralization occurs between members of the group /j, tʃ, s/. (In Andalusia and almost all Spanish-speaking South America, the opposition θ/s does not exist and interestingly, the realization of /s/ in "seseo" dialects is alveolar or alveolo-dental, closer to the place of articulation for /t, d/ and very different from the typical Castillian [s] which is almost retroflex.) In spite of this, as /j/ has the same distribution as /b, d, g/ and the same relationship with /tʃ/ and /s/ as /b, d, g/ have with their voiceless stop and fricative counterparts, it would be preferable to symbolize the four phonemes in the same manner and /β, ð, ɣ, j/ would be more representative of their realizations.

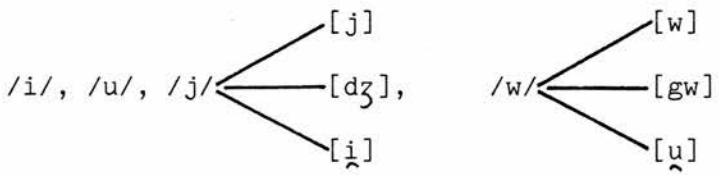
3.3 Semi-consonants

The third problem concerns the two approximants (or semi-consonants) [j] and [w] and their vowel counterparts [i], [u]. This has been discussed by various authors (Trager, 1939; Bowen and Stockwell, 1955, 1956; Alarcos, 1974; Harris, 1969). To go into the problem in depth is not within the scope of this chapter so the main systems are presented as follows:

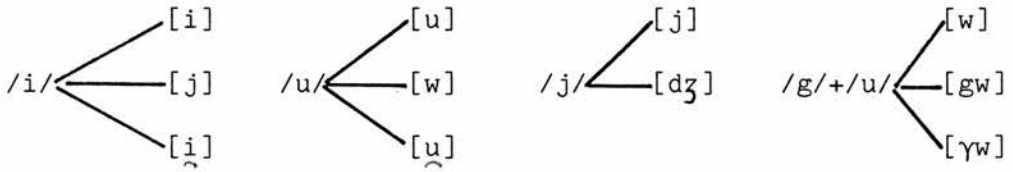
Trager



Bowen and Stockwell



Alarcos



Trager's system is based on Navarro Tomás' "Pronunciación Española" and he does not take into consideration at all the velar fricative or approximant which precedes [w] where the latter is in syllable-initial position, e.g. "son huevos" [soŋgweβos] or [soŋγweβos] (they're eggs) as opposed to "son neuvos" [son‿nweβos] (they're new). [j] and [i̯] are allophones of /i/ and are in complementary distribution. [w], [u̯] and [u] are treated similarly. Bowen and Stockwell consider all pre- and post-nuclear sounds as allophones of the two consonantal phonemes /j/ and /w/. So [j] occurs syllable-initially in fricative/approximant contexts, e.g. "mayor" [major] (major) and as second member of clusters, e.g. "piedra" [pjeδra] (stone). [w] also occurs as second member of clusters, e.g."nuevo" [nweβo] (new). [dʒ] and [gw] occur syllable-initially in stop contexts, e.g. un hielo [undʒelo] (piece of ice), un huevo [uŋgweβo] (an egg). The difference between them is that /w/ does not occur intervocalically word-medially as does /j/.

Alarcos follows Trager's system but allocates the consonantal groups [gw] or [γw] to two phonemes /g/ + /u/. This seems to be the tidiest system. [j] is an allophone of /i/ when it is not syllable-initial,

e.g. [pjeðra] and an allophone of /j/ when it is e.g. [major]. [w] is always an allophone of /u/ as it does not occur syllable-initially except perhaps in rapid speech when it could be in free variation with [γw], e.g. el huevo [el γweβo] [el weβo]. However, even if the element [γ] does not appear to be present, the voicing is still assimilated by the previous consonant. Compare "las huela" [laz'(γ)wela] (he smells them) to "la suela" [la'swela] (the sole of a shoe). [i] [i̯] and [j] are in complementary distribution as described above and similarly [u] [u̯] and [w] which is acceptable as long as one assumes that the type of diphthong conditions the articulation and not vice-versa. In certain contexts, [i̯] and [j] can be in free variation, e.g. piedad [pje'ðað] or [pi̯ə'ðað].

4. Syllable Structure

Spanish has a relatively simple syllable structure compared to English, allowing only up to five phonemes per syllable word-medially and four, word-finally:

e.g. (C) (C) V (C) (C)
/ t R a N s k R i β θ i o N /(transcription)
(C) (C) V (C)
/ t R e s / (three)

VCV admits all consonant phonemes word-medially but word-initially, /r/ and /r r/are neutralized /R/ and realized as [rr]. However, /ɲ/ is very uncommon in this position and only occurs in words of foreign origin, e.g. ñame [ɲame] (kind of yam).

CCV admits the following combinations:

/p/ /b/ /f/ /k/ /g/	+	L	[plato] (plate), [primo] (cousin)
		R	[blando] (soft), [bruto] (stupid)
			[flete] (freight), [frotar] (to rub)
			[klaro] (light), [kraneo] (cranium]
			[glorja] (glory), [grano] (grain)
/t/ /d/	+	R	[trepar] (climb)
			[droγa] (drug)

Word-medial VC admits six archiphonemes and /s/, and VCC only archiphonemes, plus /s/.

	VC		VCC	
/B/	[aβsoluto]	(absolute)	[aβstraer]	(abstract)
/D/	[aδlas]	(atlas)	[aδskrito]	(subscribed)
/G/	[eɣsamen]	(exam)	[eɣskusa]	(excuse)
/N/	[andar]	(walk)	[transpirar]	(sweat)
/R/	[arte]	(art)	[perspikaθ]	(perspicacious)
/L/	[alto]	(tall)	[solstiθjo]	(solstice)
/S/	[este]	(this)		

Word-final VC admits only four archiphonemes and /s/ (/G/ if we consider "reloj"[rrelo(x)])

/D/	[maδriδ]	(Madrid)	/s/ [tos]	(cough)
/N/	[ben]	(come)		
/R/	[komer]	(to eat)		
/L/	[el]	(he).		

CHAPTER III

IDENTIFICATION OF LANGUAGES BY PROSODIC FEATURES

1. Introduction

Chapter I presented an overview of writers' opinions, observations and experimental results relating to language rhythms, in particular those of English, French and Spanish. In general, linguists seem to accept the concept of stress-timing for English, certainly as a perceptual phenomenon although there is also evidence of manipulation of timing towards isochronous units from instrumental studies. French and Spanish have both been described as syllable-timed. This has been questioned by some writers and certainly, if a French speaker imposes the rhythm of his native language on Spanish, or vice-versa, the result is noticeably "foreign". If French and Spanish can both be classified within the same group, the languages should not be identifiable if all other variables, segmental and prosodic, are removed from the speech signal.

Two perceptual experiments are described in this chapter. The first was designed to find out whether a linguistically sophisticated group of people could identify different languages on the basis of prose rhythm alone and also whether an analysis of errors in the responses would help to form a basis on which to build a hypothesis concerning the nature of rhythm in Spanish. The second experiment emerged from the first. One of the subjects who had participated in the first experiment questioned its validity as he was not sure that he had been listening for rhythmic cues, mainly the recurrence of stressed syllables. The second experiment was devised therefore to find out if listeners could in fact identify stressed syllables and unstressed from the severely distorted speech signal. The conclusions reached here are backed up by analysis of data from acoustic experiments in following chapters.

The languages used in the experiments were English, French and Spanish. Most would agree that English and French have very different rhythms, whether they accept the stress-timing/syllable-timing distinction or not.

As we have seen in Chapter I, opinions differ as to the nature of Spanish rhythm. Spanish would appear to share some of the characteristics of its rhythm with stress-timed languages and some with syllable-timed or maybe the rhythm is dependent on some other recurring feature which is not the syllable or the equivalent of the English "foot".

Other attempts have been made to ascertain whether languages can be identified by their prosodic features alone. Ohala and Gilbert (1978) quote Atkinson (1968) and Bonte (1975) who generated a pulse signal having the same frequency and amplitude as the original speech. Atkinson used English and Spanish for identification and Bonte used English, French and Chinese. Bush (1967) experimented with low-pass filtered speech using American English, British English and Indian English and Richardson (1973) used the same method with Black English and White English.[2] All results showed success of identification to be above the chance level.

Maidment (1978) experimented with laryngographic recordings of French and English. Thirty-six listeners were asked to identify forty-four utterances as being English or French and the results were statistically significant. However, no information is given about the native language(s) of the listeners or their linguistic proficiency.

[2] I tried this method but found it to be unsatisfactory as a low-pass filter which would effectively remove all segmental cues produced a lack of clarity in the voicing signal which affected perception of the rhythmic features.

Ohala and Gilbert presented speech signals to listeners which retained only the frequency, amplitude and timing with respect to stretches of voicing. They recorded fifty-four passages in this way from spontaneous conversation of which eighteen were American English, eighteen Japanese and eighteen Cantonese and of the forty-one listeners who did the test, eighteen were native speakers of American English, twelve of Cantonese and eleven of Japanese. They also prepared a training session which was presented to all but five of the listeners.

Although they say in the instructions which were presented to the listeners: "This is a test to find out if people can recognize a language based on the intonation pattern alone" (Ohala and Gilbert, 1978 : 128), earlier on in the article they state that the above languages, American English, Japanese and Cantonese have been used "primarily because...they represent three distinct prosodic types: languages using stress, accent, and tone, respectively" (Op.cit:127) thereby admitting at least in the use of the first two terms "stress" and "accent", that rhythm is also a cue to identification. The results were very significant statistically; the overall correct responses being 56.4% of the total and 58.1% excluding the responses of the listeners who were not given the training session. These results are reproduced in Table 5, where E = English, J = Japanese and C = Cantonese. As well as proving that these three languages could be successfully identified by their prosodic features alone in conversational speech, they also verified the following hypotheses:

TABLE 5

Identification of American English, Japanese and Cantonese by prosodic features
Results of Ohala and Gilbert's experiment (Ohala and Gilbert,1978:30)

Table 1 Monolinguals (N=12)

Presented \ Heard	E	J	C
E	140	51	25
J	52	85	79
C	46	69	101

correct : 50.3%

Table 2 Bilinguals (N=25)

	E	J	C
E	280	113	57
J	87	238	125
C	85	76	289

correct : 59.3%

Table 3 Trilinguals (N=4)

	E	J	C
E	34	13	25
J	22	40	10
C	23	8	41

correct : 53.2%

Table 4 English (with training passage) (N=13)

	E	J	C
E	168	39	27
J	50	102	82
C	53	64	117

correct : 55.1%

Table 5 English (no training) (N=5)

	E	J	C
E	49	29	12
J	26	31	33
C	19	32	39

correct : 44.1%

Table 6 Japanese (N=11)

	E	J	C
E	107	74	17
J	39	95	64
C	43	31	124

correct : 54.9%

Table 7 Cantonese (N=12)

	E	J	C
E	130	35	51
J	46	135	35
C	39	26	151

correct : 64.2%

Table 8 Short Passages

	E	J	C
E	222	92	55
J	83	201	126
C	98	61	210

correct : 55.1%

Table 9 Long Passages

	E	J	C
E	232	85	52
J	78	162	88
C	56	92	221

correct : 57.7%

Table 10 Total (all conditions, all listeners)

	E	J	C
E	454	177	107
J	161	363	214
C	154	153	431

correct : 56.4%

Table 11 Correct Identifications

	Listeners' Own Lang.	Other Languages
Observed	463	785
Expected by chance	416	832

Table 12 Misidentifications

	Other Language as listener's own	Other language as other language (& vice-versa)
Observed	339	352
Expected by chance	345.5	345.5

1. Long passages will be better identified than short passages.
2. The listener will be more successful at making the distinction own language/not own language as opposed to the distinction other language/other language. (This result was not significant statistically.)
3. Identifications will be improved if listeners are given a prior training session incorporating both the original unprocessed voice signal along with the processed version.
4. Bilingual or trilingual speakers (of the languages used in the test) will outperform monolinguals. (Only the bilinguals' scores were significantly better than the monolinguals'.)

2. Method of Experiment 1

In the present study, the first experiment was carried out along very similar lines, but I attempted to isolate rhythm as the only independent variable. It is difficult to measure the extent to which this was achieved, but in a pilot study where no attempt was made to isolate rhythm, results were significantly better so it is hoped that intonation was used less as a deciding factor in the final experiment.

2.1 Materials

Recordings were made in English, French and Spanish by native speakers of Southern English, Northern French and North Castilian Spanish respectively, of a short passage from Jules Supervielle's short story "L'Arche de Noe" (1949 : 11). The complete text in the three languages is contained in Appendix 1. The translations into Spanish and English were done by native speakers of these languages and the text changed slightly on occasions so that the three texts would take approximately the same time to read if read at the same tempo. This text was chosen as it is from a contemporary work which is written in

conversational style. The vocabulary and syntax is simple and the sentences relatively short. It was decided to use a read text rather than spontaneous conversation because in the latter, it is often difficult to find stretches of connected speech which contain typical rhythmical patterns unsullied by hesitations, interruptions, lengthy pauses, excessive emphasis, etc. Speakers were asked to read the passage in "slow conversational style". None of them knew which features were to be examined in the experiment.

The recordings were made on two tracks simultaneously. Track I was a normal audio recording through a microphone and Track II, a laryngographic recording using a Laryngograph Processor manufactured by Laryngograph Ltd.[2a] For this, two electrodes were placed on each side of the speaker's throat and electrical impulses passing through the larynx were recorded. The recordings were segmented according to tone-groups. Pauses were taken as criteria for establishing tone-group boundaries when they coincided with semantic boundaries.* Each utterance was then played back several times and the recording of the original French and the two translations compared to ascertain whether intonation patterns, tempo and pitch range were similar between at least two of the languages involved in each case. When two utterances were found in which the above-mentioned features were felt to be ambiguous, they were marked for use in the test tape. This was an attempt to isolate rhythm as the only variable. As mentioned earlier, it must have been partially successful but not completely so, as many of the listeners remarked that they had used intonation as a cue for identification on two or three occasions.

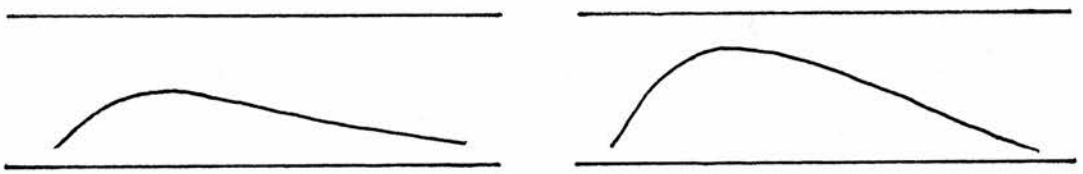
2a. The laryngograph is generally agreed to present an accurate measure of fundamental frequency and some indication of the glottal waveform. The relationship between signal amplitude and acoustic energy is poorly understood, but it is not straightforward. The same is true of amplitude and subjective loudness.

*See also Note on Terminology p. 440.

Of the utterances which were singled out in this way, thirty were used in random order for the test tape, ten English, ten French and ten Spanish. The thirty utterances in order of presentation are contained in Appendix 2. In deciding which utterances to use, several problems were encountered which may have affected the final result.

Firstly, the Spanish speaker had a greater overall pitch fluctuation but maintained the same tessitura. The French speaker also had a wide pitch range but changed tessitura several times. The English speaker on the other hand, had a small pitch fluctuation in any one tone-group but seemed to have a wider range of tessitura. This made it difficult to find ambiguous intonation patterns between any two languages, especially between English and Spanish. When the intonation contour appeared to be the same, there would be the following difference in range (graphically represented here):

English **Spanish**



French and Spanish intonation contours which were very similar were easier to find. This may have contributed to confusion between Spanish and French.

Secondly, both the French and the English speakers exhibited a certain amount of creaky voice especially in tone-groups of a falling intonation ending on a low pitch. This was not remarked on however, by the listeners.

Thirdly, both the Spanish and French unstressed syllables were heard as louder and more clearly defined than the English. (This of course can be considered a feature of the rhythm, along with syllable duration.)

Fourthly, the French speaker, although stressing the last syllable, in most words, tended to change this in some words in utterance final position. One example was "...pendant les vingt-quatres heures de la journée" where the stress fell on the first syllable of "journée". Stress on the penultimate syllable of words is very common in Spanish.

These factors could have been used as cues for identification and caused confusion between the languages concerned.

2.2 Presentation

The experimental tape was composed firstly of instructions to listeners as follows:

> "In this experiment, you will hear laryngographic recordings of thirty utterances. You are required to state which language you think the laryngographic recording is from. You will see that three languages have been used in the whole experiment, but in each utterance there is a choice of only two. Please tick the appropriate box on your answer sheet and do not omit any ticks, even if you are not sure. Intonation patterns have been used which would be appropriate to either language so please base your decision on rhythm as far as possible. The thirty test utterances will be repeated twice each. You will first hear short laryngographic recordings of the three languages."

These laryngographic recordings were only to familiarize subjects with that type of sound as most of them had not heard it before. Subjects were not trained in any way as I wished the responses to be subjective and impressionistic rather than as a result of a learning process. Had they had a training session, it would probably have affected the results as Ohala and Gilbert discovered.

Subjects were asked to fill in their name, field of work/study, native language and their own opinion of their proficiency in other languages on the answer sheet. They had to tick the appropriate box for each numbered utterance as in the example:

1. English ☐ French ☑

Each utterance was heard twice with a time lapse of two seconds before the repetition and another lapse of five seconds for deciding on the response. Utterances ranged from 1.6 seconds to 8.7 seconds in duration. For utterances longer than this, it would have been impossible to find common or ambiguous intonation patterns.

There were four groups of listeners; ten native English speakers, ten native French, ten native Spanish and a miscellaneous group of ten who spoke a variety of native languages but who all knew English to varying degrees and most had, at least, a smattering of one of the other languages used. The majority of the listeners were post-graduate students or staff of the Linguistics Department of Edinburgh University so their interest lay in various aspects of language but their proficiency in the three test languages was very varied. It was impossible to measure the listeners' mastery of the two languages which were not their native language so I had to take their word for it. This is reproduced in Table 6 with each listener's correct score

out of thirty. It can be seen at a glance that the level of proficiency in the languages concerned, affected the results.

3. Results of Experiment 1

The results are presented in Tables 7 to 11. Table 7 shows the results of each individual listener and the groupings are according to native languages. The bilinguals and near trilinguals were asked which language they felt was dominant and allotted to the groups accordingly. From this Table it can be seen that the Spanish group on the whole was more successful in identifying all three languages and also that the English and the Spanish groups identified Spanish better than the other two languages. The group of native Spanish speakers contained a higher proportion of listeners with good knowledge of the other languages which must have accounted for their higher scores. In the French group, the success in identification is reversed between French and Spanish which is hardly surprising as very few of the native French speakers had any knowledge of Spanish (cf. Table 6). The Miscellaneous group had a much lower success rate on the whole, except for two speakers who were proficient in English and French. If a training session had been included, the Miscellaneous group may have been more successful. The experiment has been criticized on the grounds that speaker recognition could have been used for language identification as only one speaker was used for each language. Had this been the case, the Miscellaneous group should have achieved a better-than-chance result, whereas in fact the result was just over 50% correct responses, chance being 50%.[3]

3. I have been informed that that there are two schools of thought concerning this point: one that familiarity with the language concerned is an aid to speaker recognition from a recording of prosodic features and the other, that it is a disadvantage to be familiar with the language (Adam Brown, personal communication).

TABLE 6

Language Identification: languages spoken and linguistic proficiency of listeners together with correct scores, Experiment 1

N° of listener	Native English	N° correct out of 30
1	French(VG)	17
2	French/Spanish(F)	17
3	French/Spanish/Gaelic(F)	19
4	French/German(F)	17
5	French(G) German	17
6	French(F)	18
7	French/German(G) Spanish/Italian(F)	19
8	French/Spanish(G)	18
9	French(F)	23
10	French(G)	21
	Native Spanish	
11	English(Fl) French(F)	18
12	English(G) French	20
13	English(G)	16
14	English/French/Italian(G)	16
15	English/French(G,HA)	20
16	English(G)	22
17	English(G,HA)	20
18	English/French(Fl)	24
19	English(B) French(G)	20
20	English(G,HA)	21

Table 6 (continued)

N° of listener	Native French	N° correct out of 30
21	English(G,HA) German	16
22	English(G,HA) German	19
23	English(B) Spanish(P)	18
24	English(G,HA) German	15
25	English(P)	17
26	Spanish(B) English	19
27	English(P)	18
28	English(F)	23
29	English/Spanish(G) German	17
30	English(B)	26
	Miscellaneous	
31	Maltese(N) English(B) Italian(G) French(F)	20
32	Persian(N) English(G,HA) French(F)	10
33	Arabic(N) Indonesian(Fl) English(F)	13
34	Arabic(N) English(F) French(P)	18
35	Japanese(N) English(F)	14
36	Arabic(N) English(F) French(P)	11
37	German(N) English(G) French(P)	14
38	German(N) English/French(G)	20
39	Shi(N) Swahili Lingala(Fl) French(Fl) English(F)	17
40	Cantonese(N) Mandarin(Fl) English(F) French(P)	15

Key: N = Native; G = Good; B = Bilingual
Fl= Fluent; F = Fair; HA= Heavy Accent
VG= Very Good; P = Poor.

TABLE 7

Language Identification

Results of Experiment I according to listeners

Native English Speakers

	Correct Responses				Incorrect Responses						
N° of listener	E	S	F	Total	EforS	SforE	SforF	FforS	FforE	EforF	Total
1	4	9	4	17	0	4	5	1	2	1	13
2	7	4	6	17	3	3	3	3	0	1	13
3	5	8	6	19	1	3	2	1	2	2	11
4	6	6	5	17	1	2	3	3	2	2	13
5	4	7	6	17	1	4	2	2	2	2	13
6	6	6	6	18	2	1	2	2	3	2	12
7	7	8	4	19	0	0	3	2	3	3	11
8	7	6	5	18	2	2	4	2	1	1	12
9	9	8	6	23	0	1	2	2	0	2	7
10	7	8	6	21	1	2	2	1	1	2	9
Totals	62	70	54	186	11	22	28	19	16	18	114
				Combined Totals	33		47		34		

Native Spanish Speakers

11	7	6	5	18	3	1	3	1	2	2	12
12	5	7	8	20	1	3	2	2	2	0	10
13	6	5	5	16	2	2	4	3	2	1	14
14	9	8	7	24	0	0	2	2	1	1	6
15	7	8	5	20	2	1	2	0	2	3	10
16	6	8	8	22	0	0	2	2	4	0	8
17	7	8	5	20	0	2	3	2	1	2	10
18	10	8	6	24	1	0	2	1	0	2	6
19	4	10	6	20	0	4	3	0	2	1	10
20	6	7	8	21	1	1	1	2	3	1	9
Totals	67	75	63	205	10	14	24	15	19	13	95
				Combined Totals	24		39		32		

E = English, F = French, S = Spanish

Table 7 (continued)

Native French Speakers

Correct Responses					Incorrect Responses						
N° of listener	E	S	F	Total	EforS	SforE	SforF	FforS	FforE	EforF	Total
21	6	5	5	16	2	2	3	3	2	2	14
22	7	5	7	19	2	0	3	3	3	0	11
23	7	4	7	18	3	2	1	3	1	2	12
24	5	6	4	15	2	3	3	2	2	3	15
25	6	6	5	17	1	3	2	3	1	3	13
26	7	5	7	19	2	2	2	3	1	1	11
27	8	5	5	18	3	2	2	2	0	3	12
28	9	6	8	23	1	1	1	3	0	1	7
29	4	8	5	17	1	3	3	1	3	2	13
30	9	8	9	26	1	0	0	1	1	1	4
Totals	68	58	62	188	18	18	20	24	14	18	112
				Combined Totals	36		44		32		

Miscellaneous Group

31	7	7	6	20	0	3	2	3	0	2	10
32	1	5	4	10	4	4	3	1	5	3	20
33	4	5	4	13	2	4	3	4	2	2	17
34	5	7	6	18	3	2	3	0	3	1	12
35	2	5	7	14	3	3	2	2	5	1	16
36	3	2	6	11	3	4	3	5	3	1	19
37	6	5	3	14	2	1	5	3	3	2	16
38	5	7	8	20	1	3	1	2	2	1	10
39	7	5	5	17	1	1	3	4	2	2	13
40	4	5	6	15	4	4	3	1	2	1	15
Totals	44	53	55	152	23	29	28	25	27	16	148
				Combined Totals	52		53		43		

TABLE 8

Summary of Table 7 in scores and percentages

Totals (excluding Miscellaneous Group)

	Correct Responses				Incorrect Responses						
	E	S	F	Total	EforS	SforE	SforF	FforS	FforE	EforF	Total
Max. Possible	300	300	300	900	300		300		300		900
Observed	197	203	179	579	39	54	72	58	49	49	321
% of Maximum	65.6	67.6	59.6	64.3	12.9	18.0	23.9	19.3	16.3	16.2	35.7
Observed comb.					93		130		98		
% of Maximum Combined					30.9		43.2		32.5		

Totals (including Miscellaneous Group)

	Correct Responses				Incorrect Responses						
	E	S	F	Total	EforS	SforE	SforF	FforS	FforE	EforF	Total
Max. Possible	400	400	400	1,200	400		400		400		1,200
Observed	241	256	234	731	62	83	100	83	76	65	469
% of Maximum	60.2	64	58.5	60.9	15.5	20.7	25	20.7	19	16.2	39.1
Observed Comb.					145		183		141		
% of Maximum Combined					36.2		46.2		35.2		

Totals according to native languages of listeners

English	Correct Responses				Incorect Responses						
	E	S	F	Total	EforS	SforE	SforF	FforS	FforE	EforF	Total
Max. Possible	100	100	100	300	100		100		100		300
Observed	62	70	54	186	11	22	28	19	16	18	114
% of Maximum	62	70	54	62	11	22	28	19	16	18	38
% of Correct	33.3	37.6	29	100							
Observed Comb.					33		47		34		
% of Maximum Combined					33		47		34		

E = English, F = French, S = Spanish.

Table 8 (continued)

Totals according to native languages of listeners

Spanish	Correct Responses				Incorrect Responses						
	E	S	F	Total	EforS	SforE	SforF	FforS	FforE	EforF	Total
Max. Possible	100	100	100	300	100		100		100		300
Observed	67	75	63	205	10	14	24	15	19	13	95
% of Maximum	67	75	63	68.3	10	14	24	15	19	13	31.2
% of Correct	32.7	36.6	30.7	100							
Observed comb.					24		39		32		
% of Maximum Combined					24		39		32		

French	Correct Responses				Incorrect Responses						
	E	S	F	Total	EforS	SforE	SforF	FforS	FforE	EforF	Total
Max. Possible	100	100	100	300	100		100		100		300
Observed	68	58	62	188	18	18	20	24	14	18	112
% of Maximum	68	58	62	62.7	18	18	20	24	14	18	37.3
% of Correct	36.2	30.8	33	100							
Observed Comb.					36		44		32		
% of Maximum Combined					36		44		32		

Miscellaneous	Correct Responses				Incorrect Responses						
	E	S	F	Total	EforS	SforE	SforF	FforS	FforE	EforF	Total
Max. Possible	100	100	100	300	100		100		100		300
Observed	44	53	55	152	23	29	28	25	27	16	148
% of Maximum	44	53	55	50.7	23	29	28	25	27	16	49.3
% of Correct	28.9	34.9	36.2	100							
Observed Comb.					52		53		43		
% of Maximum Combined					52		53		43		

TABLE 9

Language Identification
Results of Experiment I according to language proficiency

	Correct Responses		
	Trilinguals	Bilinguals	Monolinguals
Maximum possible	150	450	510
Observed	108	310	309
% of maximum	72	68.8	60.6

Note: Trilinguals include those listeners who spoke all three languages fluently.

TABLE 10

Language Identification

Results of Experiment I comparing own language/other language

	Correct Identifications	
	Listener's own language	Other languages
Observed	199	380
Expected	193	386

	Misidentifications		
	Other language as listener's own	Listener's own as other language	Other language as other language
Observed	101	105	115
Expected	107	107	107

TABLE 11

Language Identification

Results of Experiment I according to number of utterance

Number of utterance	Language of utterance	Choice of language	Correct identifications out of 40
1	F	E/F	31
2	E	S/E	18
3	E	E/F	27
4	S	E/S	28
5	S	F/S	22
6	S	E/S	22
7	F	E/F	23
8	E	E/S	28
9	E	E/S	22
10	E	E/F	23
11	F	E/F	31
12	F	E/F	24
13	E	E/S	18
14	F	E/F	27
15	S	E/S	32
16	S	E/S	28
17	E	E/F	27
18	F	F/S	15
19	S	F/S	23
20	E	E/S	32
21	S	F/S	29
22	F	F/S	25
23	S	F/S	24
24	E	E/F	24
25	S	E/S	27
26	F	F/S	24
27	E	E/F	22
28	F	F/S	18
29	F	F/S	16
30	S	F/S	21

E = English, F = French, S = Spanish.

Table 8 is a summary of the totals in Table 7 in actual scores and in percentages according to listeners and according to each language. The overall total of correct responses excluding the Miscellaneous group was 579, i.e. 64.3%. Applying the Chi Squared test, this result is significant at the 0.001 probability level. The overall total of correct responses including the Miscellaneous group, 731, i.e. 60.9% is still significant at the 0.001 probability level.

Comparing the totals of correct identification of the three languages, Spanish (67.6%) is slightly higher than English (65.6%). English and Spanish were both identified more successfully than French (59.6%), but a comparison of these results is not of statistical significance.

Comparing the totals of correct identification according to the groups of native speakers, the Spanish group achieved the highest success rate (68.3%) but this is not significantly greater than the native English and French groups who achieved 62% and 62.6% respectively.

With regard to the percentages of correct language identification for each of the groups of native speakers, the results for the English and Spanish groups were very similar, the identification of Spanish being the most successful in each group, secondly English and thirdly French. However, for the French group, English takes first place, French second and Spanish third. Comparing the correct identification of Spanish between the Spanish, English and French groups, 36.6%, 37.6% and 30.8% of correct responses respectively, this was not found to be significant. These results do show however, a tendency towards better identification of languages with which one is familiar. For the Miscellaneous group, the order of successful identification was, first French, second Spanish and third English.

An analysis of the types of error of all groups, excluding the Miscellaneous group (cf. Tables 7 and 8) shows a higher proportion of confusion between French and Spanish than between English and French or Spanish and English. Applying the Chi Squared test, this was found to be statistically significant at the 0.05 probability level. This applied to all groups independently of the correct identification, but was less significant for the French group.

The number of instances in which a) French and English, and b) English and Spanish were confused was not significantly different (cf. Table 8), so the extent to which the rhythms of these three languages differ could be represented by an almost isosceles triangle where E=English, F=French, and S=Spanish, including percentages of utterances confused, rounded off:

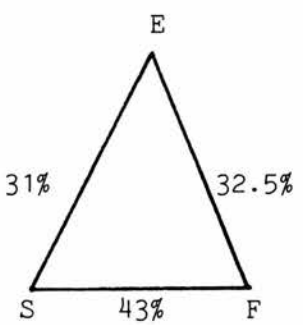


Table 9 shows that bilinguals and trilinguals achieved better results than monolinguals; trilinguals 72% correct, bilinguals 68.8% correct and monolinguals 60.6% correct. Applying the Chi Squared test, both the trilinguals' and bilinguals' results were significantly better than the monolinguals at the 0.01 and 0.05 probability levels respectively.[4]

Listeners were slightly better able to identify their own language than the others (Table 10), but the difference was not significant. The English group also misidentified other language for other language

4. This agrees with Ohala and Gilbert's results except that in their experiment, bilinguals were the most successful.

to a greater extent than their own language for other or vice-versa (Table 10), but this was probably due to the fact that French and Spanish overlapped to a greater extent.

Table 11 shows the number of correct choices which were made for each test utterance and again most of the results were considerably lower where the choice was between Spanish and French. Errors were not restricted to any particular utterance.

No correlation was found between length of utterance and success in identification, such as quoted in Ohala and Gilbert's results. This was probably due to the ambiguity of the intonation contours or the fact that there was less variety in length of utterance. Successful identification seemed rather to depend on clarity of syllable division and typical rhythmic groupings. As mentioned previously, the French speaker reversed the stress on a few occasions in utterance final position, placing it on the penultimate syllable which is a typical Spanish stress placement and many of the listeners interpreted these utterances as Spanish. For example in utterance N° 29 "Pourquoi l'écureuil a-t-il un queue presqu'aussi grosse que lui et qui le suit comme un reproche?" (Why is the squirrel's tail nearly as big as himself and follows him round like a curse?), the stress was placed on "re" instead of "proche" in the final word and the utterance was interpreted as Spanish by the majority : 16 correct identifications out of a possible maximum of 40. Conversely in the Spanish utterances where the syllable division was not clear - in fact impossible to hear between the final and penultimate syllables, subjects possibly perceived the stress as falling on the final syllable and consequently identified the utterance as French. For example in N° 30 "Ni un segundo seco en las veinticuatro horas del día" (Not a single dry

moment throughout the whole day) "día" is composed of two syllables. This sentence was judged as French on 19 occasions out of forty.

4. Subjects' Impressions

After taking part in the experiment, each subject was asked which cues he thought he had relied on mostly for identification. The following were mentioned several times:

French
- "Staccato" type rhythm
- Periods of voicing of equal duration
- Little variation in loudness
- Utterance final syllables stressed
- Lively intonation.

Spanish
- Periods of voicing of equal duration
- More variation in loudness than French
- Utterance penultimate syllables stressed
- Pitch rising to stressed syllables
- Lively intonation.[5]

English
- Stressed syllables heard as louder than unstressed
- Unstressed syllables of unequal duration
- Stressed syllables tend to fall at equal intervals
- Onset of voicing less "sharp"
- Intonation less lively than other two languages.

Although these answers were very impressionistic and it is impossible to prove that in fact these were the cues being used, it does seem that rhythm played an important part and many of the above-mentioned cues are in fact characteristic of the languages concerned, for example, greater variation in loudness in Spanish than French and the pitch rising onto the stressed syllables in Spanish (cf. reference to

5. Navarro Tomás' observations are in contradiction to this in his Manual de Entonación and Manual de Pronunciación Española.

Navarro Tomas, Chapter I, p. 33). The remarks on intonation are probably speaker-dependent rather than language-dependent.

It is perhaps worth mentioning that most of the subjects found it a rather tortuous experience and could not be very definite about the cues they had been listening for. As mentioned before, one listener, although he obtained a high score in identification, could not pinpoint any cues and was not sure whether he was able to distinguish stressed from unstressed syllables. The following experiment was carried out therefore in an attempt to prove that it is possible to perceive the rhythm from laryngographic recordings.

5. Method of Experiment 2

Ten of the shorter utterances were chosen, four English, three Spanish and three French and the native speakers who had recorded them were asked to mark syllable division and stressed syllables. They could listen to both tracks of the recording if they wished. I did the same independently and the results were compared. Where there was a difference of opinion, I consulted with a third or fourth person but I eventually made the final decision.

This exercise, which was done prior to the experiment, brought out some interesting points. My syllable division was practically identical to that of the native English speaker's but not so the stress markers. On the other hand, my Spanish stress markers were identical to those of the Spanish speaker but we differed slightly on syllable division. The French syllable division was reasonably straight-forward but there were differences of opinion as to which syllables carried stress. I consulted with another native French speaker and a native English speaker with a good knowledge of French before making the final decision.

The difficulty with French seemed to lie in confusion between emphasized and stressed syllables. When an utterance-final word was emphasized, it was stressed on some other syllable than the final.

After deciding on the number of syllables, stressed syllables and where silent stresses or pauses occurred in each test utterance, the ten utterances chosen for this secondary experiment were written out thus:

e.g. 5. - - - - - - - - - ^ - - - - - -

where each dash represents a syllable and ^ a pause or silent stress.

Four listeners who had been successful in identifying the languages in the first experiment were asked to listen to the laryngographic recordings of these ten utterances again and mark the stressed syllables thus:

e.g. 5. - + - + - - + - ^ + - - - + -

They were given an unlimited time to perform the test. Stresses were considered as correctly identified if they were spot on the stressed syllable and also if groups between pauses were out of phase by one syllable,

e.g. 5. - - + - + - - + ^ + - - - + -

If only one stress was missed by one syllable,

e.g. 5. - - + + - - + - ^ + - - - + -

it was marked as incorrect, i.e. the first stress mark in the example. Stress marks placed where no stresses existed were also marked as incorrect.

6. Results of Experiment 2

This test was performed very successfully. The results are given in Table 12 and stressed syllables were identified rather better than languages in the previous experiment.

TABLE 12

Language Identification:

Results of Experiment 2

Identification of stressed syllables

	Correct identification of stressed syllables		
N° of listener	English	Spanish	French
1	14	10	13
2	21	11	14
3	18	10	16
4	18	12	16
Totals	71	43	59
Maximum possible	96	52	84
% of maximum	74	82.7	70.2

Discrepancies include misplaced stresses and non-existing stresses. The Chi Squared test was applied and the result was significant at the 0.001 level of probability. Listeners were less successful in distinguishing stressed from unstressed syllables in the French utterances.

If we accept English as a stress-timed language, the rhythm depends on the recurrence of stressed syllables and from this experiment it would appear that stressed syllables are clearly perceived as stressed on the laryngographic recording. Whether Spanish is stress-timed or syllable-timed, or neither, remains to be seen, but the fact that listeners were able to mark the stressed syllables and to estimate the correct number of unstressed syllables between them shows that the rhythm was being heard,

e.g. 16. Y cada‿una pensaba por su parte

\- - + - - + - - - + -

(And everyone thought for himself).

In this utterance, the syllable division in "una" and "(pen)saba" is impossible to hear on the laryngographic recording and yet all four listeners left the correct amount of unstressed syllables between the first and second, and second and third stresses. This implies that they divided the space between the stressed syllables according to how many unstressed syllables they thought would 'fit', basing this on some preconceived notion of how long an unstressed syllable should last. This would appear to favour syllable-timing in Spanish, at least within unstressed groups of syllables.

7. Summary of Results

Before going on to a further discussion, the results of both experiments are summarized below for convenience.

7.1 Experiment 1

1. It is possible to identify languages from their prose rhythm alone.
2. Listeners are better able to identify languages with which they are familiar.
3. Trilinguals and bilinguals are more successful than monolinguals with little knowledge of the other languages concerned.
4. French and Spanish were confused to a much greater extent than English and French or Spanish and English.
5. Spanish was better identified than English and French (not of statistical significance).
6. Listeners were slightly better able to identify their own language (not of statistical significance).

7.2 Experiment 2

1. Listeners were able to distinguish stressed from unstressed syllables on a laryngographic recording.
2. Listeners were successful in identifying stressed syllables in the following order according to languages:
    1. Spanish
    2. English
    3. French.

8. Discussion and Hypotheses

What emerges of real interest to the present study is result N° 4 of Experiment 1; the results of Experiment 2; and the problems involved in setting up Experiment 2.

I wish to refer back to the difficulties we had in deciding on syllable division and stressed syllables for Experiment 2. The agreements and disagreements could be tabulated as follows:

	Stresses	Syllable Division
Spanish	Agreed	Disagreed
English	Disagreed	Agreed
French	Disagreed	Agreed

From this table, Spanish would appear to be the odd man out which, in fact, I believe it is. If we accept English as being stress-timed, stressed syllables are isochronous or tend towards isochrony. It is therefore of little importance if two consecutive syllables carry the correlates of stress to the same degree. That syllable which preserves the isochrony will be heard as stressed in connected speech. In test utterance N° 2

"I really need it to have enough room to think
about each one of you", replied the lion.

there was disagreement as to whether "(e)nough" and "one" were stressed, and heard in isolation, they certainly sounded just as prominent as "room" and "each" but the final decision was made on the basis of preserving the isochrony. On the other hand agreement was reached immediately concerning syllable division. Syllables in English are of varying durations and syllable quantity can play an important phonological role within the foot (Abercrombie, 1965 : 26-34). It is important therefore that boundaries are clearly defined.

If Spanish does tend towards syllable-timing (and it would appear so from the results of Experiment 2), syllables should follow each other at more or less equal intervals of time. In many instances in the test utterances, 'sinalefa' was produced, i.e. a word final vowel combined with word initial vowel of the following word to form a diphthong or one of the vowels was elided, in both cases forming only

one undifferentiated vocalic segment. In these instances it was sometimes difficult to decide whether there was one syllable or two. In rapid speech the two syllables are usually collapsed into one. The final decision was based on length. If the segment approximated the length of two syllables rather than one perceptually, they were counted as two and vice-versa. Surprisingly enough, the listeners' identification corresponded to the marking of stressed and unstressed syllables done by the native speaker and myself, indicating that they were listening for syllabic isochrony, at least among non-utterance final syllables. (Long utterance final syllables were not correctly identified as one.)

On the other hand, stresses are extremely important in Spanish for differentiating word meanings and indeed for comprehension. If a stress is wrongly placed by a non-native speaker, likely as not a Spaniard will not understand him. If one cannot rely on isochrony for identifying stressed syllables, nor on the structural position of the syllable within the word (many are accented on the penultimate syllable but many are not), they must be well-differentiated by phonetic correlates, namely pitch and intensity rather than duration (cf. Chapter I). This would explain the identical stress placement and the success of the listeners in identifying Spanish stress in Experiment 2.

French exhibited a definite tendency towards CVCV structure and the following are two interesting examples,

"Pourquoi tu as la....."

".....cette pluie....."

"Tu as" was pronounced as one syllable [tɥa] and "cette" as two [sɛtə]. Word accent does not differentiate meaning in French and although the

word final syllables were generally stressed in these utterances, sometimes the penultimate syllable sounded more prominent and sometimes stress was used for emphasis as in

".....en commençant par.....".

— + — — —

This made it difficult to reach a decision as to stress placement in French and also difficult for the listeners in Experiment 2 who were presumably expecting utterance final stress placement.

Result 4 of Experiment 1, the fact that Spanish and French were confused to a much greater extent than English may have been caused by several factors and perhaps speaker-dependent characteristics should not be completely discarded. However, French and Spanish do seem to have more in common, namely their stressed syllables do not occur as regularly as in English, unstressed syllables tend to have similar durations in each language respectively and stressed syllables tend to fall towards the end of the utterance (utterance final in French, penultimate or final in Spanish). It is clear however, that the two languages differ rhythmically. They cannot be clumped together in the same group. If they are both syllable-timed, then there are various types of syllable-timing. If syllabic isochrony is to be preserved, duration should not be at the top of the list of stress correlates. It was seen in Chapter I that duration plays a minor role in Spanish compared to English but the studies are of very different varieties of Spanish and results differ quite widely. The following chapter examines stress correlates in Spanish, particularly duration, which, it is suspected, will emerge as a very weak correlate, or not at all.

CHAPTER IV

THE PHONETIC CORRELATES OF STRESSED SYLLABLES IN SPANISH

1. Introduction

From the results of the perceptual experiments described in the previous chapter, the hypothesis was drawn that there is a tendency towards syllabic isochrony in Spanish but that at the same time, for various reasons, stressed syllables must be clearly defined from unstressed. If syllabic isochrony is to be preserved in Spanish - or nearly so, the phonetic correlates of stress should be features which do not affect the relative durations of syllables. Durational features would be expected to play a lesser role as a correlate of stress in Spanish than say in English, a stress-timed language.

The experiment described in this chapter is to determine what the phonetic correlates of stress are in Spanish and to a certain extent, their relative importance. Traditionally, only pitch, intensity and duration have been examined and results have indicated that pitch and intensity are of more importance than duration, some authors favouring pitch and others intensity.

Navarro Tomás (1963) distinguishes these three correlates:

> "El sonido sobre el cual recaen principalmente la intensidad, la cantidad y el tono, se llama sonido acentuado. En el caso de que estos elementos se den separadamente sobre sonidos diferentes, conviene distinguirlos en particular, llamandoles según el elemento de que se trata, acento de intensidad, acento de cantidad y acento tónico o de altura."
> (The sound upon which intensity, duration and pitch fall, is called the stressed sound. In cases where these three elements occur separately, it is convenient to distinguish them, calling them according to the element concerned, intensity stress, duration stress and tonic or height stress.)
> (Navarro Tomás, 1963 : 26).

He indicates that "acento de intensidad" is that which is most frequently used in "grupos de intensidad" (stress groups), (op. cit.: 29), "acento de tono" is normally used on the tonic syllable but also in isolated stress groups where the intensity stress and pitch stress combine, although this is not compulsory (op. cit.: 30) and duration

stress is a property of the vowel in particular positions in the word (op. cit.: 201) (cf. Chapter I, p.30). He also adds another type "acento rítmico" (rhythmic stress):

> "en series silábicos de cierta extensión, el oído, por lo que al acento se refiere, cree percibir un movimiento alternativo de aumento y disminución, en virtud del cual, las sílabas débiles, a partir de la sílaba fuerte de cada grupo, se distinguen entre si, destacando u oscureciendose sucesivamente."
> (in long series of syllables, the ear, as far as the stress is concerned, believes it hears a certain alternating movement of increase and decrease by which the weak syllables apart from the strong syllable of each group, are distinguished from each other, by standing out and becoming obscured successively.)
> (Navarro Tomás, op. cit.: 195).

Ethel Wallis (1951) equated pitch height with stress using Pike's 1-4 pitch phoneme system with the highest pitch as the stressed syllable. This of course led her to give examples such as ? No has comido? where
3 3 1
to consider "do" as stressed would be unacceptable to any Spaniard.

Graham Pointon (1978) quotes Bolinger and Hodapp (1961) who in answer to this said it was not necessarily the syllable with the highest pitch that was stressed but that syllable whose pitch "deviated from the norm", i.e. highest and lowest pitches.

In an experiment carried out by Contreras (1963) using individual words with different stress patterns, he concluded that pitch was more important than intensity and duration for the recognition of stress. The pitch must be either low or high on the syllable in question compared to the rest of the utterance or it must be changing as opposed to static. Where pitch is not a reliable indication, increased duration indicates stress even if the syllable has less intensity. This would seem to indicate that pitch, duration and intensity are important for stress recognition in that order, but if Navarro Tomás is right, studying individual words will necessarily combine intensity stress and tone stress, as the stressed syllable also becomes the tonic.

These results correspond to Fry's findings for English, where an increase in duration and/or intensity will cause a syllable to be perceived as stressed (Fry, 1958), but a difference in duration is a more important factor than intensity. The longer a syllable is, or the louder it is, the more likely it is to be perceived as stressed. However, a pitch rise or fall on only the syllable in question, whatever the difference in frequency, will cause that syllable to be recognised as stressed. It would appear from Fry's and Contreras' results that these three parameters have the same order of importance in English as in Spanish.

That this should be so, or that these should be the only stress correlates in Spanish is difficult to believe. Even allowing for differences in vowel quality between stressed and unstressed syllables in English which barely exist in Spanish, a native English speaker's perception of stress in Spanish is usually extremely inaccurate and many misunderstandings occur from incorrect stress placement in production and/or perception of the speech continuum.

The following acoustic experiment is designed to determine what the phonetic correlates of stress are in Spanish and to what degree they are present and overlap.

2. Method

2.1 Materials

Two sets of sentences were used in this experiment. The first set consisted of twenty-six sentences, thirteen of which contained the word "'Papa" and thirteen identical sentences with "'Papa" replaced by "pa'pa". The words "'Papa" and "pa'pa" (meaning Pope and Daddy/father respectively) were chosen because both syllables have the same

segmental composition, so assuming that the change in quality from stressed to unstressed vowel is very slight (cf. Chapter V, p.220), the relative intensity, pitch and duration should not be affected by intrinsic values which might occur if the syllables contained different segments.

Two other pairs exist in Spanish which have the same segmental composition and are differentiated by stress only but they were difficult to embed in identical frame sentences, viz. "Ma'ma" (Mummy) /"'mama" (mammary gland, breast) and "'bebe" (he/she/it drinks)/ "be'be" (baby). Six different tone groups which have been differentiated functionally were used (Obregon, 1981 : 53-54) and the key word placed in as many different positions as possible, i.e. tonic, post-tonic, pre-tonic. The sentences used are on pages 109 and 110 , together with an approximate graphical representation of each intonation contour. The position of the stressed syllable in the variable word is indicated in brackets after each frame sentence. Dotted lines indicate sections of intonation contours which may or may not be present. This set was mainly designed to investigate the roles of pitch and intensity. The data for all speakers are contained in Appendix 2.

The second set consisted of twenty-nine sentences all said on Tone 1, falling intonation. The words embedded in the frame sentences are again minimal stress pairs. In some sentences I have placed the pronouns "el" and "yo" before the words in question in order to avoid any effects which might be caused by the word occurring utterance-initially. All five vowels have been used with different consonant combinations. This set was designed mainly for the purpose of investigating duration as a stress correlate. Obviously the segmental

composition of the syllables affects their duration but the aim of this part of the experiment is to establish ratios between stressed and unstressed syllables of identical segmental composition. The full list of sentences in Set 2 is on page 111.

The syllables to be examined are underlined and the position of the stressed syllable in the tone group is indicated in brackets after each sentence. Sentences 20, 22 and 25 have had an extra syllable added to the stress group of which the stressed syllable in question is initial, to find whether the ratio stressed/unstressed is affected by the number of unstressed syllables between stressed. This is investigated more thoroughly in a later chapter.

2.2 Procedure

The two sets of sentences on pp. 109-111 were recorded under studio conditions by four native speakers of Spanish, three male, one female, of different ages and from different parts of the Spanish-speaking world. JG is from N. Castile , LR from Andalucia, AS from Caracas, Venezuela and JF from Ciudad Juarez, Mexico. They were asked to read the sentences at their normal tempo and as naturally as possible. As the first intonation contour illustrated for Tone 4 was not natural to all the speakers, they used whatever intonation was natural to them in order to convey a certain element of disbelief or surprise in an interrogative utterance.

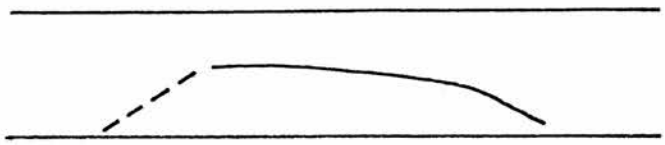
Mingographic tracings were then made of the sound wave (recorded by microphone), pitch fluctuation (using the Frokjaer-Jensen pitch computer), intensity fluctuation (using the intensity meter) and a time trace. The tracings were segmented considering these three parameters in conjunction with audible evidence of segmental division using the speech segmenter (University of Edinburgh, Linguistics Department).

Sentences used for determining stress correlates in Spanish.

English translation appears in brackets

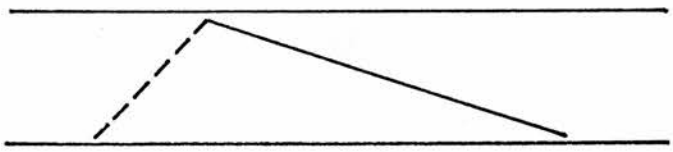
Set 1 'Papa/pa'pa

Tone 1 Falling tonic on last stressed syllable.



(1) El 'Papa se 'fue (pre-tonic, medial) (The Pope went)
(2) El pa'pa se 'fue (pre-tonic, medial) (The father went)
(3) Se 'fue el 'Papa (tonic, penultimate) (The Pope went)
(4) Se 'fue el pa'pa (tonic, final) (The father went)

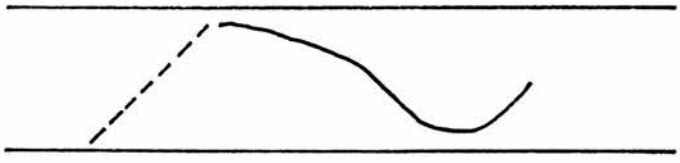
Tone II Falling from high tonic



(5) 'Como se 'fue el 'Papa? (post-tonic, penultimate)
(How did the Pope go?)
(6) 'Como se 'fue el pa'pa? (post-tonic, final)
(How did the father go?)
(7) 'Como se 'fue el 'Papa tan 'pronto? (post-tonic, medial)
(Why did the Pope go so soon?)
(8) 'Como se 'fue el pa'pa tan 'pronto? (post-tonic, medial)
(Why did the father go so soon?)
(9) 'Fue el 'Papa quien lo 'hizo (tonic, medial)
(It was the Pope who did it)
(10) 'Fue el pa'pa quien lo 'hizo (tonic, medial)
(It was the father who did it)

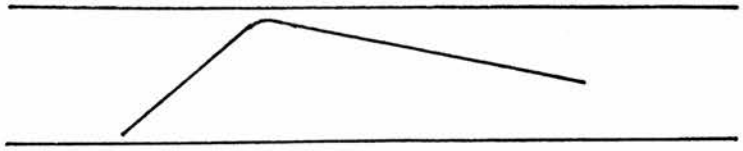
Tone III (High rise), fall, rise to mid-level.

Tonic on last stressed syllable.

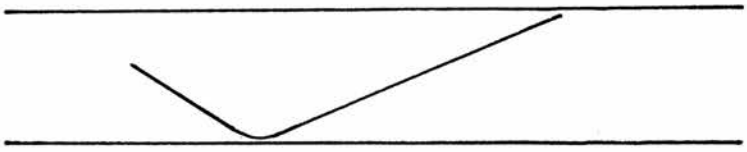


(11) El 'Papa se 'fue? (pre-tonic, medial) (Did the Pope go?)
(12) El pa'pa se 'fue? (pre-tonic, medial) (Did the father go?)
(13) Se 'fue el 'Papa? (tonic, penultimate) (Did the Pope go?)
(14) Se 'fue el pa'pa? (tonic, final) (Did the father go?)

Tone IV Either Rise-fall from very high tonic to mid level

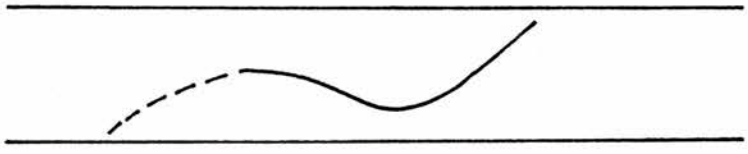


Or Fall, high rise from low tonic



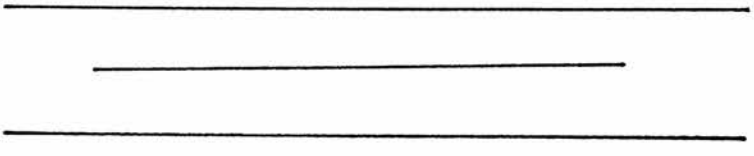
(15) 'Es el 'Papa quien 'habla? (tonic, medial)
(Is it the Pope that's speaking?)
(16) 'Es el pa'pa quien 'habla? (tonic, medial)
(Is it the father that's speaking?)
(17) 'Que dices? Que el 'Papa ro'bo? (pre-tonic, medial)
(What are you saying? That the Pope stole?)
(18) 'Que 'dices? Que el pa'pa ro'bo? (pre-tonic, medial)
(What are you saying? That the father stole?)

Tone V Mid rise, fall, high rise. Tonic on last stressed syllable.



(19) Se 'fue el 'Papa, (o 'no se 'fue)? (tonic, penultimate)
(Did the Pope go, (or didn't he)?)
(20) Se 'fue el pa'pa, (o 'no se 'fue)? (tonic, final)
(Did the father go (or didn't he)?)
(21) El 'Papa se 'fue, (o 'no se 'fue)? (pre-tonic, medial)
(Did the Pope go (or didn't he)?)
(22) El pa'pa se 'fue, (o 'no se 'fue)? (pre-tonic, medial)
(Did the father go (or didn't he)?)

Tone VI Level possibly slightly rising. Moveable tonic depending on intensity



(23) 'Hay 'cada 'Papa' (tonic, penultimate)
(There are some funny Popes!)
(24) 'Hay 'cada pa'pa' (tonic, final)
(There are some funny fathers!)
(25) Te'nemos un 'Papa tan 'bueno' (pre-tonic, medial)
(We have such a good Pope!)
(26) Te'nemos un pa'pa tan 'bueno' (pre-tonic, medial)
(We have such a good father!)

Sentences used for determining stress correlates in Spanish

Set 2

Tone 1 Falling intonation

(1) 'Yo ter'mino 'tarde (pre-tonic, medial) (I finish late)
(2) 'El termi'no 'tarde (pre-tonic, medial) (She/he finishes late)
(3) 'Yo ter'mino (tonic, penultimate) (I finish)
(4) 'El termi'no (tonic, final) (She/he finishes)
(5) Oja'la can'tara como 'ella! (pre-tonic, medial)
(I wish I/he/she/ could sing like her)
(6) Nunca canta'ra como ella! (pre-tonic, medial)
(He/she will never sing like her)
(7) Oja'la can'tara (tonic, penultimate)
(I wish I/she/he would sing)
(8) 'Nunca canta'ra (tonic, final) (He/she will never sing)
(9) 'Yo 'chupo con 'gusto (pre-tonic, medial) (I suck with relish)
(10) 'El chu'po con gusto (pre-tonic, medial) (He sucked with relish)
(11) Me 'dice que 'chupo (tonic, penultimate)
(He/she/you tells me I suck)
(12) Me 'dice que chu'po (tonic, final)
(He/she/you tells me he/she sucked)
(13) 'Rezo 'tres 'veces al 'dia (pre-tonic, initial)
(I pray three times a day)
(14) Re'zo 'tres 'veces al 'dia (pre-tonic, medial)
(He/she prayed three times a day)
(15) 'Muchas 'veces 'pillo 'cosas (pre-tonic, medial)
(I often snatch things)
(16) 'Muchas 'veces pi'llo 'cosas (pre-tonic, medial)
(He/she often snatched things)
(17) Encua'derno mis libros (pre-tonic, medial) (I bind my books)
(18) Encuader'no mis libros (pre-tonic, medial)
(He/she bound my books)
(19) 'El 'bebe 'muchas 'cosas (pre-tonic, medial)
(He drinks a lot of things)
(20) El be'be ve 'muchas 'cosas (pre-tonic, medial)
(The baby sees a lot of things)
(21) El 'Papa 'reza 'bien (pre-tonic, medial) (The Pope prays well)
(22) El pa'pa pa'rece 'bien (pre-tonic, medial)
(The father seems to be alright)
(23) 'Yo 'saco 'todos los 'libros (pre-tonic, medial)
(I take all the books out)
(24) 'El sa'co 'todos los 'libros (pre-tonic, medial)
(He took all the books out)
(25) 'El sa'co to'ditos (pre-tonic, medial) (He took all of them out)
(26) 'Yo 'bajo corriendo (pre-tonic, medial) (I come rushing down)
(27) 'El ba'jo corriendo (pre-tonic, medial) (He came rushing down)
(28) 'El 'toma 'te ca'liente (pre-tonic, medial) (He drinks hot tea)
(29) El to'mate ca'liente (pre-tonic, medial) (The hot tomato).

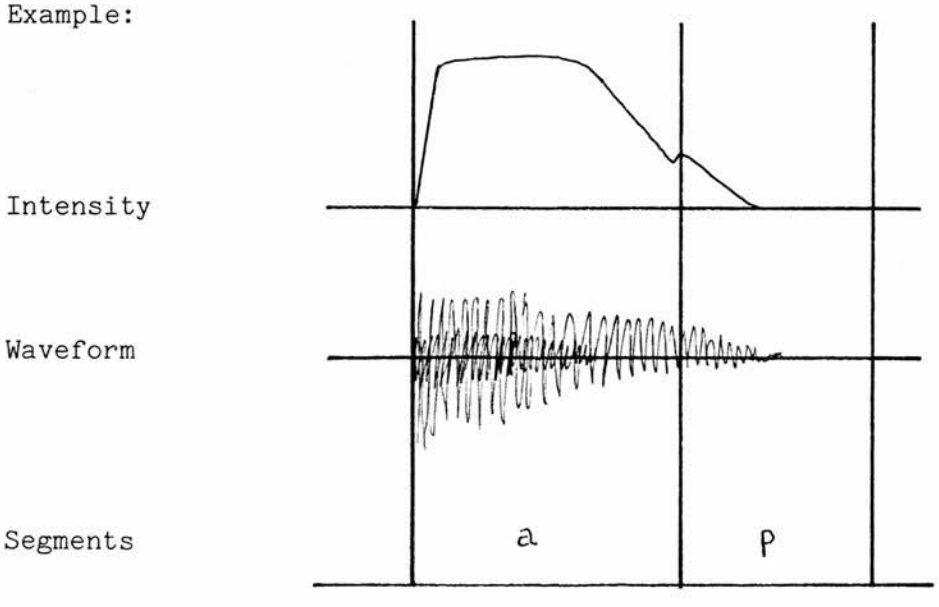
Every effort was made to ensure accurate segmentation and where this was not possible, at least consistent.

Several problems were encountered and the following criteria were used in dealing with them:

(1) The duration of any aspiration on release of the consonant was allotted to the vowel and not to the preceding consonant. This is because vowels plus aspiration have the same durations as vowels with no aspiration. It is usually very slight and seems to be accidental rather than a feature of the realization of voiceless stops in a particular phonetic context.

(2) Especially in the case of a vowel followed by a voiceless stop as releasing consonant of the following unstressed syllable, voicing is likely to continue briefly during closure, and if the closing phase has been slow, it is extremely difficult from any of the tracings to find any precise indication of where to segment. In these cases, it was necessary to segment according to the mid-point of the transition, i.e. a point midway between the end of the steady state of intensity and the base lines, which usually coincided with a small secondary peak in the intensity tracing.

Example:

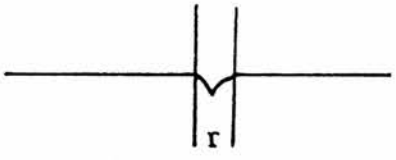


See also the second example in Figure 18. On other occasions, this small peak did coincide with an obvious change in the wave form so there is some justification for using this method.

(3) Voiced fricatives and approximants were difficult to segment and on a few occasions, impossible. Where there was a reasonably obvious change in the wave form, it coincided with a change in quality which could be perceived audibly on the recording (with the help of the segmenter), so this was taken as the point for segmentation.

(4) In the case of voiceless fricatives [s], [θ] and [x], the same problem presented itself as for voiceless stops, the difference being that while there was no obvious point for division in the wave form, the onset of high frequency friction could easily be heard for [s] and [θ] even though voicing had not stopped completely and this was taken as the starting point for the segment. In the case of [x], the frequencies are very much lower and a dividing point was not obvious, even audibly. The segmenting line was drawn through the mid-point of the transition, as previously explained.

(5) The durations of [r] and [rr] were measured from beginning of dip(s) to end of dip(s) on the intensity tracing,

e.g. 

The duration of a short intrusive vowel which is almost inevitable between [r] and a stop consonant was included with that for [r],

e.g. [t e r ᵊ 'm i n o].

3. Results : Set 1

The results are presented in Tables 14 to 24. Although the 'Papa/pa'pa set was initially intended to serve as data for analysis of pitch and intensity, it was soon obvious that many other factors come into play as correlates of stressed and unstressed syllables in Spanish. I would like to comment on each of these factors in general before discussing pitch in more detail.

Table 14 shows a syntagmatic comparison of the features of stressed and unstressed syllables in the words 'Papa/pa'pa. The stressed syllable was considered to have extra duration if the difference limen was as great or greater than the just noticeable difference quoted in Lehiste (1970) for Stott (1935) and Henry (1948) (see Table 13). There is obviously a big difference between the figures of Ruhm et al. (1966) and others, however, according to Lehiste:

> "The difference limens established by Ruhm et al. represent the limit of perceptibility under optimal conditions, whereas it appears likely that in a speech condition, the just-noticeable differences established by Henry and Stott may apply."
>
> (Lehiste, 1970 : 13).

These just-noticeable differences have been used as criteria for establishing durational differences throughout the experiment.

3.1 Durational Features

The first three correlates in Table 14 concern durational features. They did not necessarily all combine. N° 1 on its own (extra duration of the stressed syllable as a whole) involving extra duration of vowel and consonant was very rare - only four occurrences for JG, (Figure 13). It was combined slightly more often with N° 2 (extra duration of stressed vowel only) - six occurrences for JG (Figure 14). All three durational correlates were combined in nine of JG's samples (Figure

TABLE 13

Just Noticeable Differences
(after Lehiste, 1970 : 12)

	Stott, 1935		Henry, 1948		Ruhm et al., 1966	
T	ΔT/T	Absolute DL	ΔT/T	Absolute DL	ΔT/T	Absolute DL
32			0.281	8.99		
40					0.0575	2.3
47			0.203	9.54		
60					0.0283	1.7
77			0.208	16.02		
80					0.0263	2.1
100					0.0260	2.6
110			0.196	21.56		
175			0.188	32.90		
200	0.142	28.4				
277			0.172	47.64		
400	0.120	48.0				
480			0.143	68.64		
600	0.115	69.0				

Weber Ratios and Mean Absolute Difference Limens for the Perception of Durations Established in Three Studies (in msec).

ΔT/T = Change in duration over reference duration.

TABLE 14

Stress Correlates in Spanish

Syntagmatic Analysis

Set 1 'Papa/pa'pa

		Number of occurrences in 26 utterances				Averages
N°	Correlates	JG Castilian	LR Andalusian	AS Venezuelan	JF Mexican	
1	Extra duration-stressed syllable as whole	19	17	14	15	16
2	Extra duration-stressed vowel only	17	16	9	10	10
3	Shortening-releasing C of stressed syllable	11	12	5	3	8
4	Voicing-releasing C of unstressed syllable	15	13	10	12	13
5	Aspiration-releasing C of stressed syllable	11	8	4	4	7
6	Gradual build up of intensity-V unstressed syl	3	6	6	3	5
7	Gradual decrease of intensity-V unstressed syl	14	16	21	20	18
8	Intensity peak higher-stressed syllable	13	15	14	10	13
9	Intensity sustained throughout stressed V	14	16	19	21	18
10	Pitch up - stressed syllable	12	10	10	9	10
11	Pitch down - stressed syllable	4	1	5	3	3

TABLE 15

Stress Correlates in Spanish

Paradigmatic Analysis

Set 1 'Papa/pa'pa

		Stressed Pos. 1 'Papa N° of occurrences in 13 utterances					Stressed Pos. 2 pa'pa N° of occurrences in 13 utterances					Averages of both Positions
N°	Correlates	JG	LR	AS	JF	Av.	JG	LR	AS	JF	Av.	
1	Extra duration-stressed syllable as whole	8	6	11	7	8	12	8	10	12	10.5	19
2	Extra duration-stressed V only	3	6	0	5	3.5	13	8	6	5	8	12
3	Shortening-releasing C of stressed syllable	2	3	0	4	2	8	5	6	2	5	7
4	Voicing-releasing C of unstressed syllable	4	4	6	3	4	8	8	7	5	7	11
5	Aspiration-releasing C of stressed syllable	6	2	2	2	3	3	4	2	1	2.5	6
6	Gradual build up of intensity-V unstressed syl.	1	5	5	1	3	3	5	5	2	3	6
7	Gradual decrease of intensity-V unstressed syl.	9	12	12	12	11	8	7	8	7	7.5	19
8	Intensity peak higher-stressed syllable	9	8	7	7	8	8	6	7	3	6	14
9	Intensity sustained-V stressed syllable	8	9	11	8	9	10	11	13	9	11	20
10	Pitch up - stressed syllable	7	7	3	3	5	2	2	2	6	3	8
11	Pitch down - stressed syllable	1	1	1	0	1	0	0	2	1	1	2

15) and numbers 2 and 3 alone combined only three times (Figure 16). As can be seen from the averages, as well as the individual results, these durational features appear to play an important role, but they are not consistent between speakers.

3.2 Voicing

Nº 4 (voicing of the voiceless releasing consonant of unstressed syllables) was a surprising feature and one which has not been previously mentioned in the literature. It was more likely to apply to the second syllable of the word in question but also applied to the first in several samples. In the first set of sentences, the only consonant phoneme examined was /p/ which, according to traditional phonetic analyses of Spanish, has only one realization [p] (although it can be followed by slight aspiration, Navarro Tomás, 1963 : 78), but in fact there was often strong voicing throughout and no closure, giving ['paβa] or [βa'pa], (Figure 13). On examining the second set of sentences, this was found to apply also to other voiceless stops and fricatives. Typical of stressed syllables was sustained uniform voicing on the vowel and abrupt onset of voicing from consonant to vowel where the consonant was a voiceless oral stop or fricative or a devoiced oral fricative or approximant (Figure 17). Nasals resisted this devoicing tendency.

Nº 5 (aspiration of the releasing consonant of stressed syllables) was not present in most of the samples and when it was, the duration was always minimal; between 5 and 10 milliseconds and not perceptible as aspiration (Figure 16). However, the releasing consonant of unstressed syllables was very rarely aspirated, and where both were aspirated, as was the case with some of the Mexican speaker's samples, this correlate was considered to be irrelevant.

Figures 13 to 20
Mingograms of 'Papa/pa'pa - Speaker JG
(Stress correlates in Spanish, Set 1)

Figure 13
Extra duration of whole stressed syllable including increase on both vowel and consonsant. Voiced realization of unstressed releasing /p/. No appreciable pitch movement on stressed /a/.

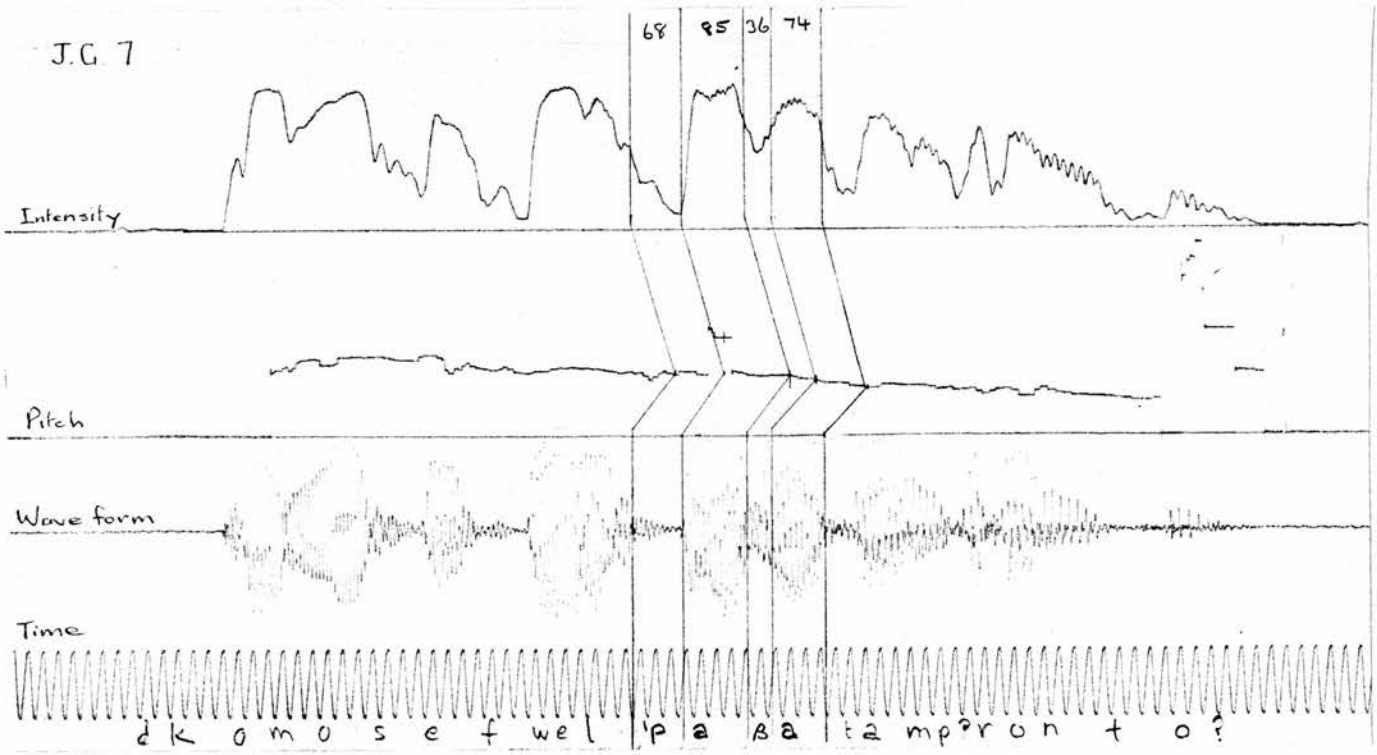


Figure 14
Extra duration of whole stressed syllable including increase on vowel only.

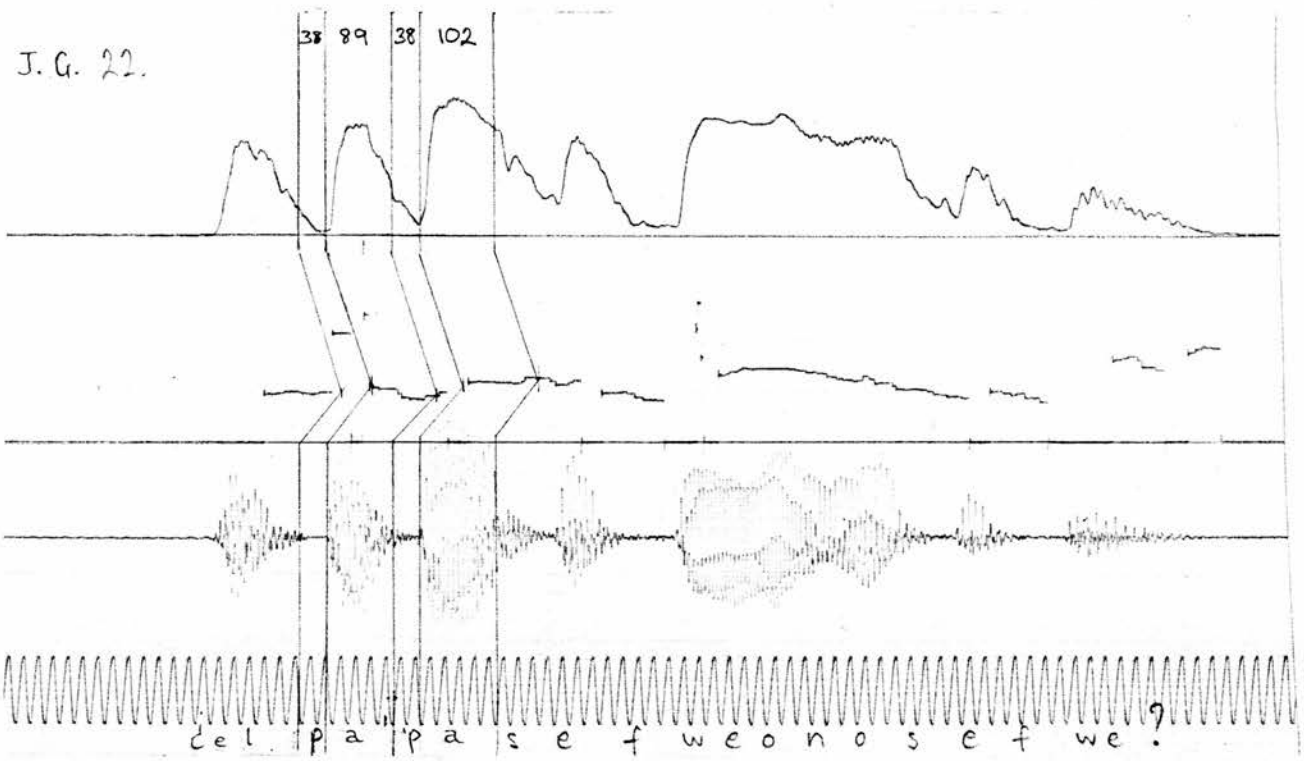


Figure 15
Extra duration of whole stressed syllable. Increase on vowel, decrease on consonant.

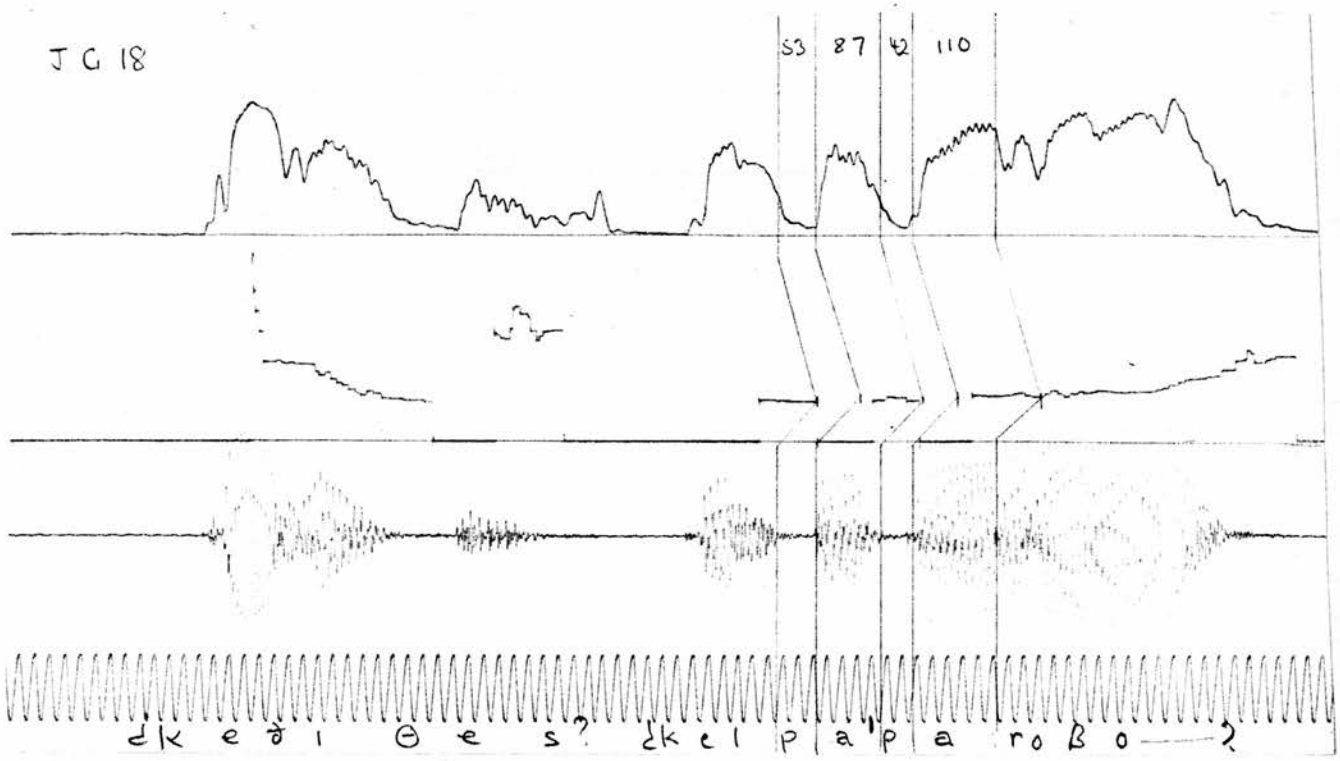


Figure 16
Syllables of approximately same duration. Increase on vowel, decrease on consonant of stressed syllable.

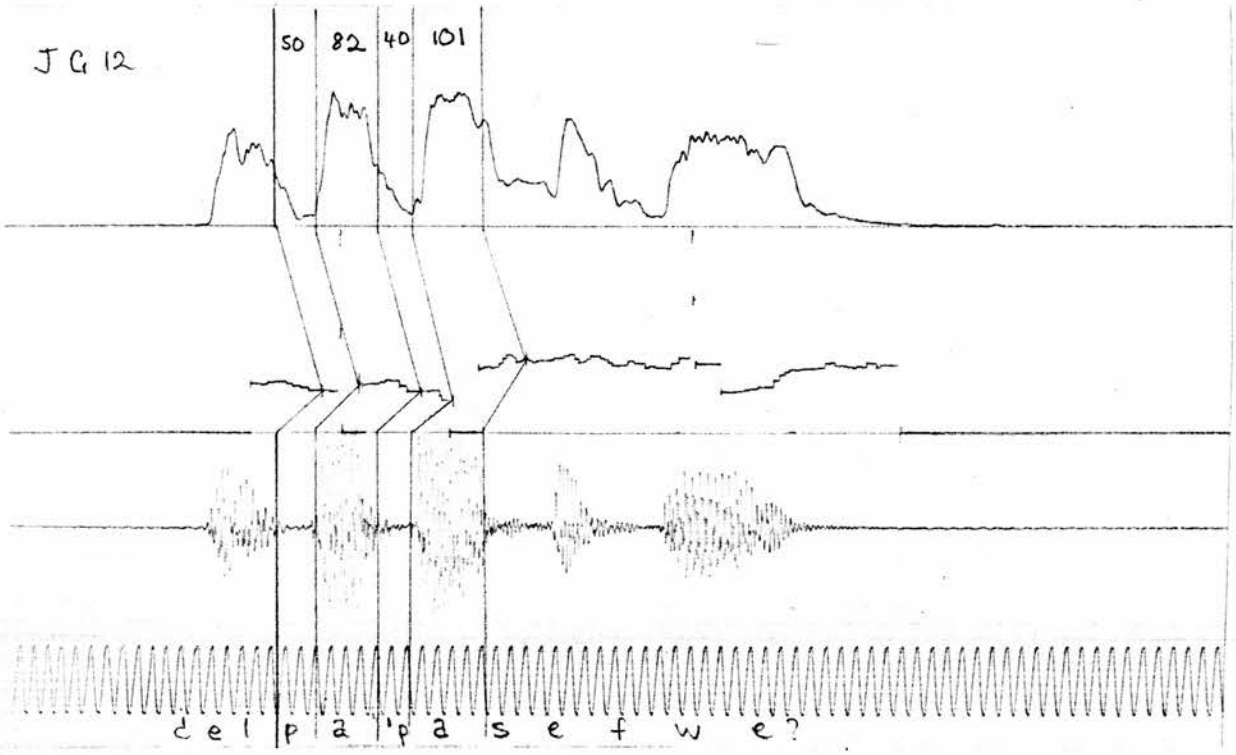


Figure 17
"Papa" in " Es el Papa quien habla?"
Abrupt voicing onset of stressed vowel.
Sustained voicing intensity on stressed vowel compared to unstressed.

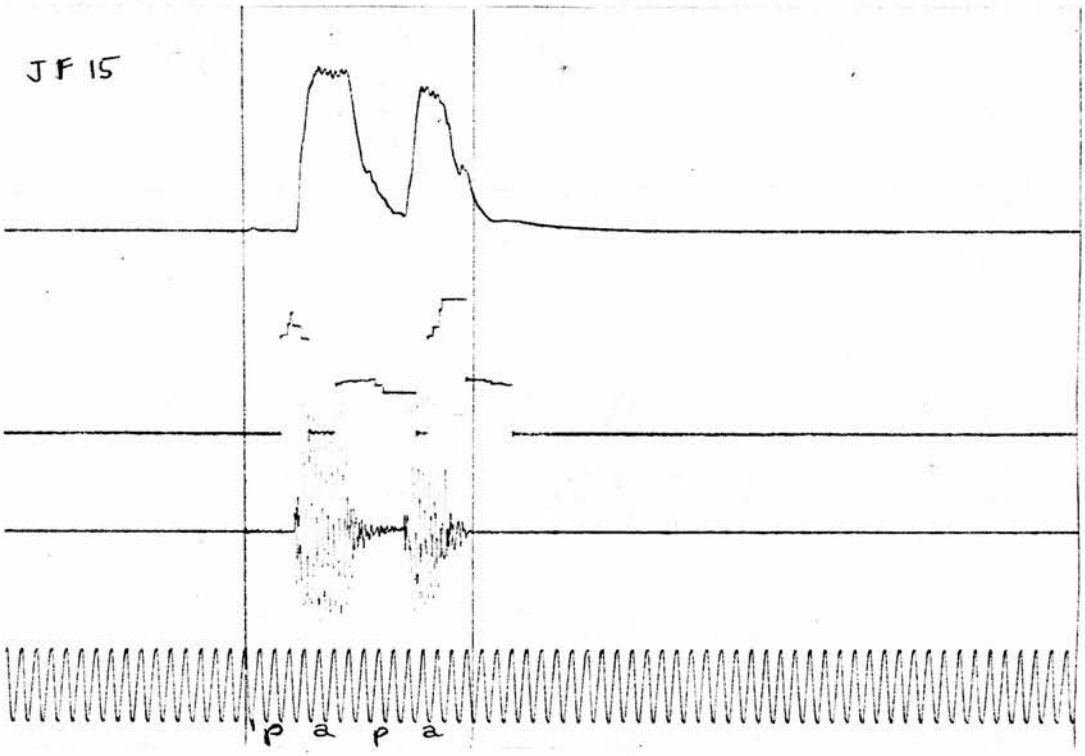
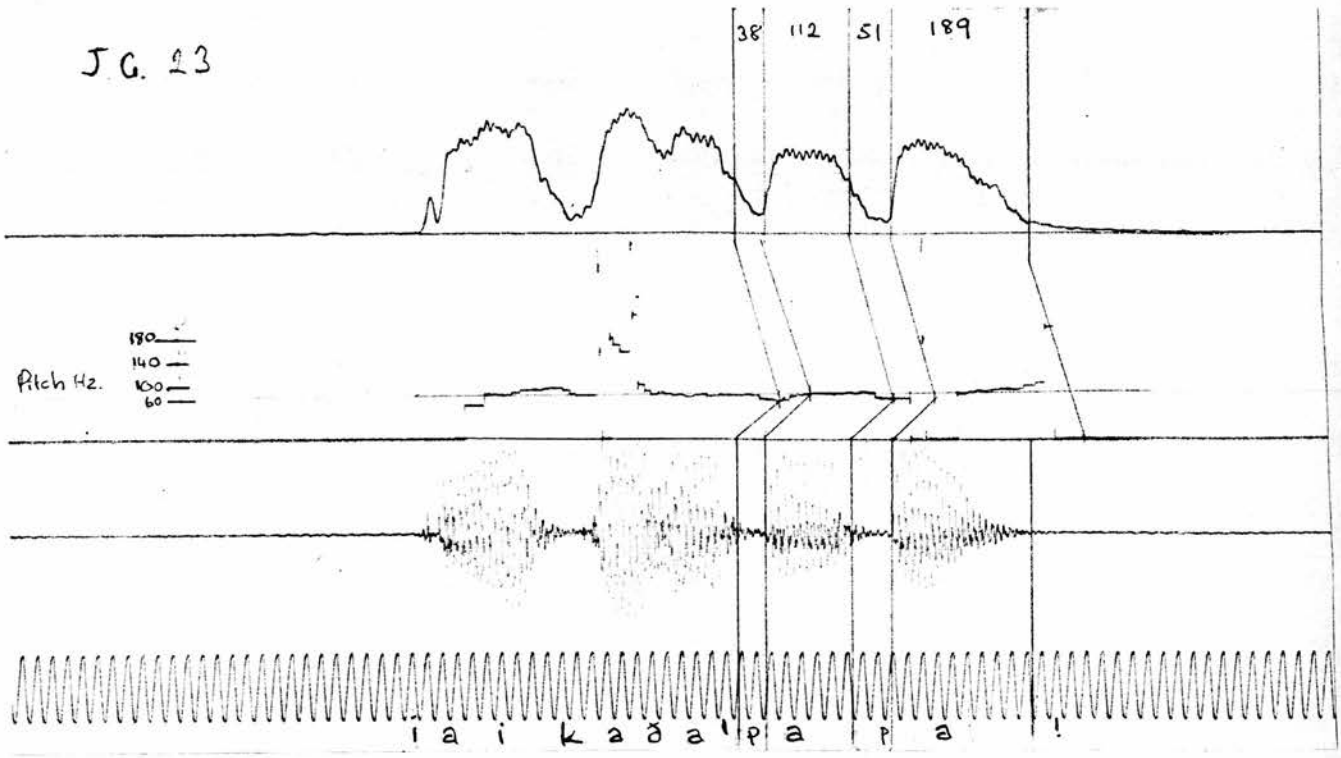


Figure 18
Examples of little or no pitch movement on stressed syllable /'pa/.



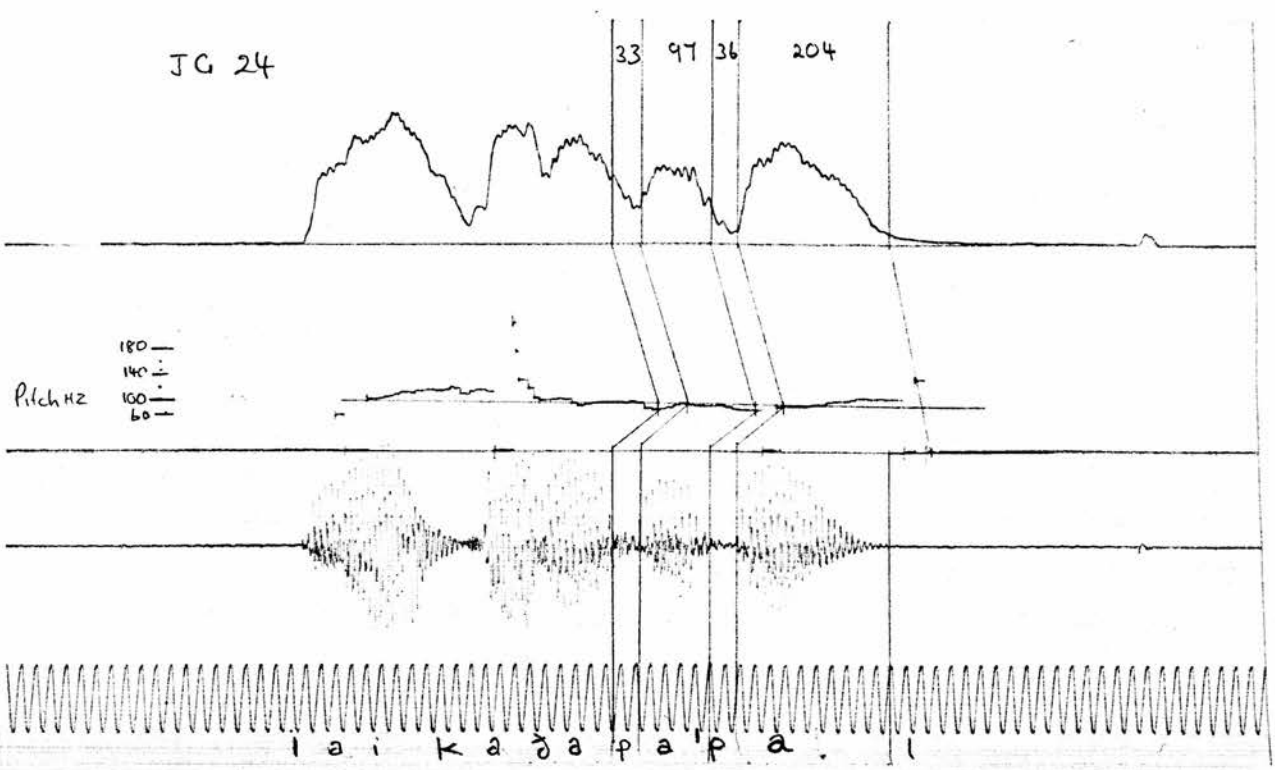


Figure 19
Example of DPM as main stress correlate.

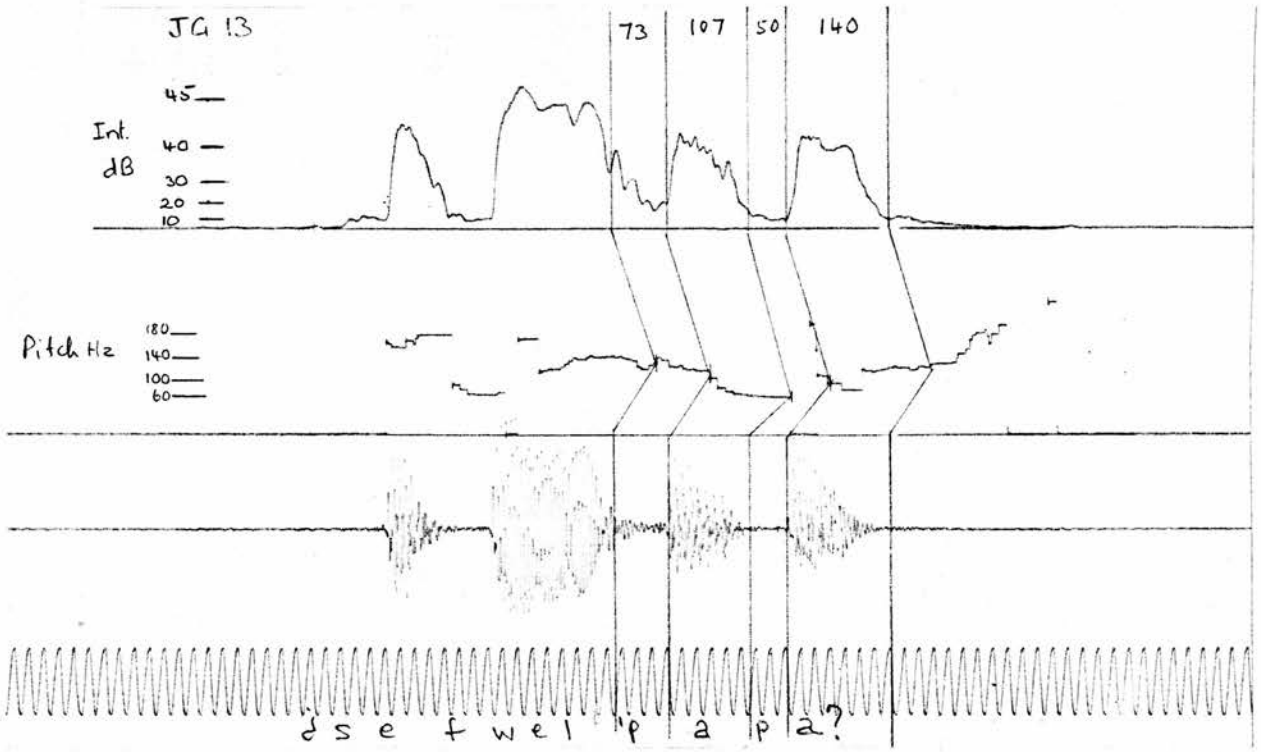
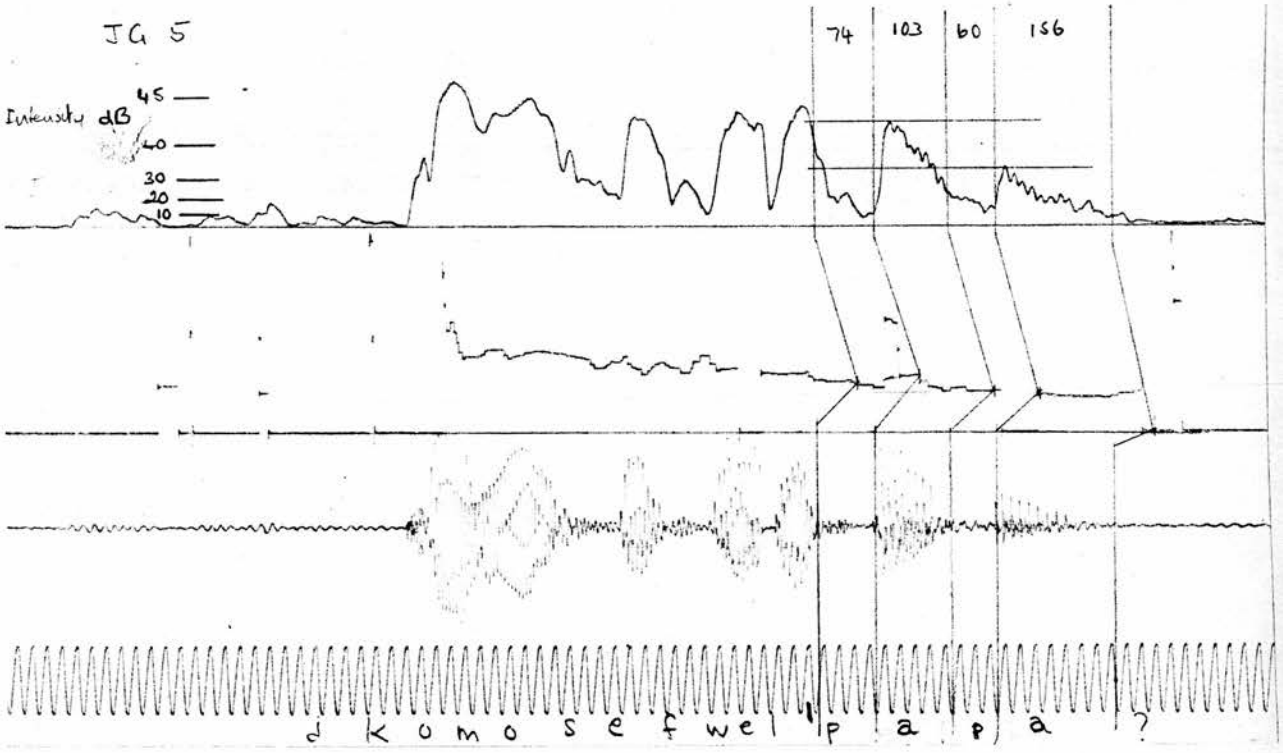
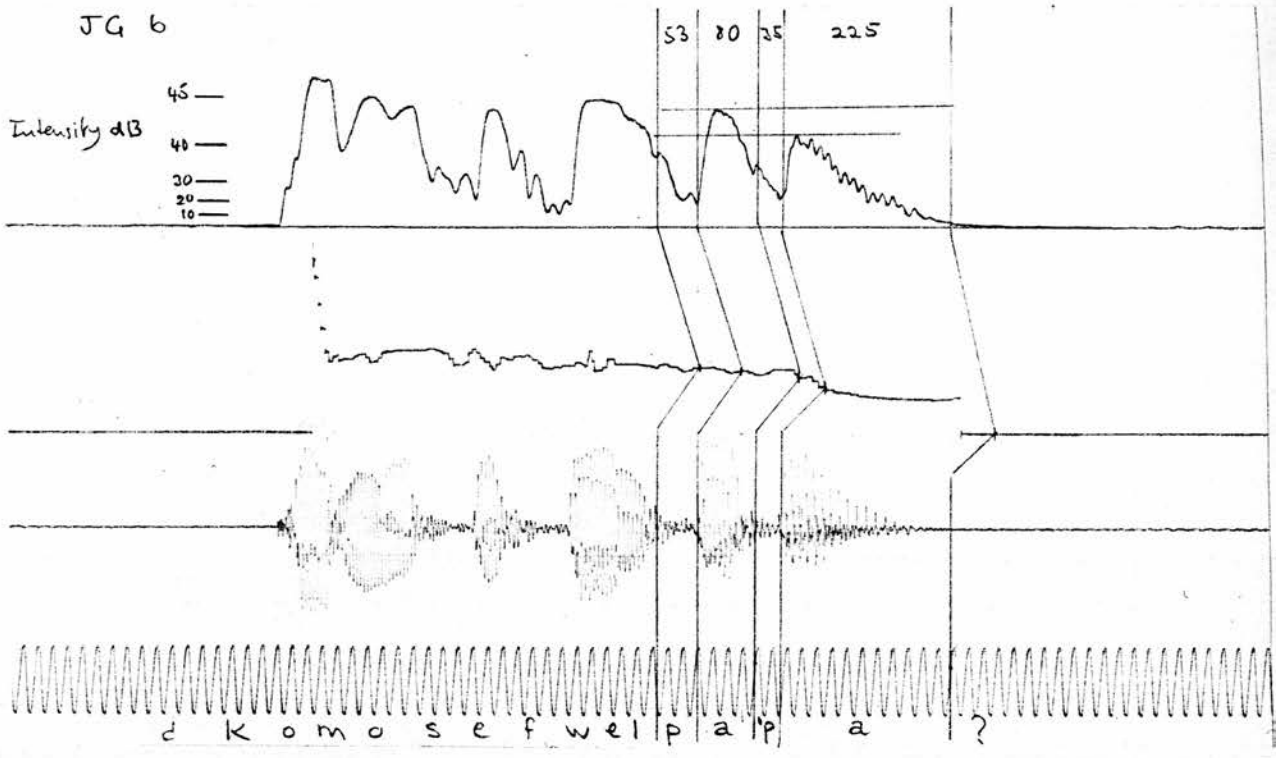


Figure 20
Example of increased intensity on final stressed syllable /'pa/ when compared paradigmatically to unstressed /pa/.





3.3 Intensity

N°s 6, 7, 8 and 9 of Table 14 concern intensity which is obviously an important parameter. N° 6 (gradual build up of intensity of the vowel in unstressed syllables) was quite rare and was always combined with N° 4. N° 7 (gradual decrease of intensity on the vowel of the unstressed syllable) was a surprisingly frequent feature and needs further investigation. It is possible that although unstressed vowels are always recognizable in Spanish (except in one phonetic environment where neutralization can occur between /i/ and /e/ or /o/ and /u/), the stressed vowel sustains its steady state longer than the unstressed. Sustained intensity throughout the duration of the stressed vowel (Table 14, N° 9) was more frequent than a higher peak of intensity (N° 8) and indeed, in several examples, the peak of intensity was higher on the unstressed vowel than the stressed, but if the intensity was not sustained on the stressed vowel, the peak tended to be higher on the latter. Average differences in peak intensity between stressed and unstressed vowels for individual speakers was very small, ranging from only 0.19 dB to 1.93 dB. Stressed syllables in utterance final position tended to have less intensity than unstressed syllables in utterance penultimate position. These final stressed syllables however, had greater intensity than their unstressed counterparts when compared paradigmatically (Figure 20).

3.4 Pitch

N°s 10 and 11 involve pitch movement. Pitch up refers either to a jump up from the previous syllable or a rise in pitch throughout the duration of the syllable in question. Pitch down is the reverse. I will use the term DPM (differentiating pitch movement) to cover any of these four variations. Although DPM occurred on quite a number of

stressed syllables and it is considered both in English and Spanish to be the most important parameter in perception of stress, in many cases it is not present. An analysis of the four speakers showed that samples in which pitch movement had occurred on the stressed syllable coincided to a remarkable degree. Four important points arose from an examination of these samples:

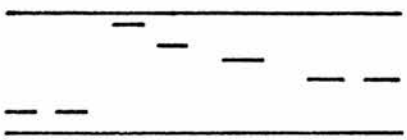
(i) Where the intonation contour requires a pitch movement, that movement is more likely to occur as a jump from unstressed to stressed or on the stressed syllable.

In the first two sentences of Set 1, "el" is unstressed and the pitch is low or mid-low. The highest pitch of Tone 1 occurs on the first stressed syllable, after which the pitch gradually descends and possibly, but not necessarily, this movement is more discernible on the last stressed syllable. The following are four examples of this type of pitch movement, schematized for clarity. In Sentence 2, pitch jump to "'pa" is not so obvious as in Sentence 1 because two unstressed syllables precede it.

	Sentence N°	
Speaker JG	1	El 'Papa se 'fue
	2	El pa'pa se 'fue
Speaker AS	3	Se 'fue el 'Papa
	4	Se 'fue el pa'pa

(ii) The tonic syllable usually carries more pitch movement than the others in the tone group, so if the stressed syllable which is under analysis occurs as tonic as in Sentence 3 above and in Sentences 15 and 16, DPM is used, I believe, as an indication, not of stress, but of the type of tone group. The extent to which the pitch rises or falls is indicative of the nature of the intonation contour. In the following example (Sentence 15), the jump from "el" to "'pa" is much greater than in Sentence 1.

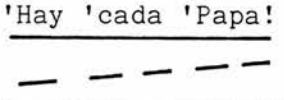
	Sentence N°	
Speaker JG	15	Es el 'Papa quien 'habla?



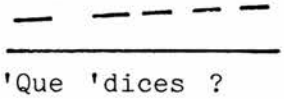
It is possible that extent of pitch fluctuation can be correlated with extra stress or prominence if the intonation contour permits the pitch fluctuation on that particular syllable. However, it is possible for the tonic syllable to be the stressed syllable of "'Papa" or "cada" in Tone 6 without using pitch movement at all.

(iii) Where the intonation contour requires (a) a smooth curve with no abrupt pitch movements, or (b) level pitch on the pretonic syllables, there is no DPM as in the following examples:

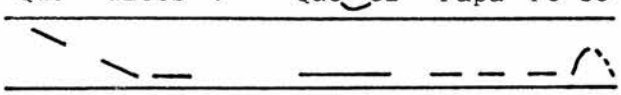
	Sentence N°	
All Speakers	23	'Hay 'cada 'Papa!



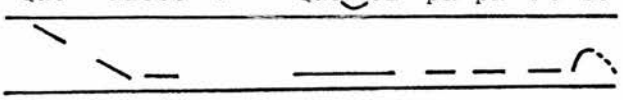
	24	'Hay 'cada pa'pa'



	17	'Que 'dices ? Que el 'Papa ro'bo ?



	18	'Que 'dices ? Que el pa'pa ro'bo ?



See also Figure 18.

(**iv**) Where the stressed syllable does carry DPM, the other correlates seem to be involved to a lesser degree and on very rare occasions, not at all, as in Sentences 13, 14, 9 and 10.

	Sentence N°	
Speaker JG	13	Se 'fue‿el 'Papa ?
	14	Se fue‿el pa'pa ?
Speaker LR	9	'Fue‿el 'Papa quien lo‿'hizo
	10	'Fue‿el pa'pa quien lo‿'hizo.

See also Figure 19.

This however is not always the case. Exactly to what degree other correlates are involved seems to depend on a series of factors. It is difficult to make any statements about the predictability of stress correlates when DPM is involved, as in many cases other parameters are present and there is obviously a certain amount of redundancy. It was tested against every other parameter separately and no correlations were found.

3.5 General discussion of results

There is remarkable similarity between the figures in Table 14 for the two Spaniards on the one hand and the two Latin-American speakers on the other. It should not, however, be inferred from this that there are rhythmic differences between the Spanish spoken in the two continents. (The subjective impression is of greater differences between other varieties of Spanish in South America.) In the paradigmatic analysis (Table 15), these similarities are not nearly as obvious and

yet the average figures for all speakers in Table 15 are very similar to the averages for all speakers in Table 14.

What emerges of interest from Set 1 is that voicing as well as durational features, intensity and pitch are obviously important correlates of stress in Spanish. All the parameters were plotted against each other in pairs but no correlations were found except a positive correlation between vowel duration and syllable duration.

As pitch has been proved to override intensity and duration in the perception of stress (Contreras, 1963), I looked at utterances in which there was no DPM. For Speaker JG, the following stress correlates were present to varying degrees:

Sentence N°

7	:	Sustained intensity, voicing unstressed /p/, duration
14	:	Duration
17	:	Sustained intensity, aspiration /'p/, slight voicing /p/, duration
18	:	Higher intensity peak
23	:	Sustained intensity
24	:	Voicing of /p/, duration
25	:	Voicing of /p/, duration (very slight increase)
26	:	Aspiration /'p/ (9 ms).

Numbers 14 and 24 were utterance final, so one would expect these syllables to be longer. Clearly, they are a very mixed bag. In numbers 14, 18, 23 and 26, only one stress correlate is present, and it is different in each case. The aspiration of /'p/ in N° 26 was barely audible and no other correlates are present, and yet the syllable is distinguishable as stressed. This is possibly because this particular speaker often voices syllable-initial unstressed /p/ and the fact that it is not voiced is sufficient in itself. The other informants produced different combinations of correlates so it was impossible to carry out any statistical tests (see Appendix 3).

All parameters were averaged from the Papa/papá experiment for all speakers, and the results presented in Table 24. Basic syllable durations were calculated from averaging all syllables in position 1 which gave one figure and all syllables in position 2, giving a different figure. The difference between these two figures is about 10 ms on average but ranged from 7 ms (Speaker JG) to 18 ms (Speaker JF). Fluctuation of dB refers to fluctuation on the vowel in question. Peak intensity was not found to be very different between stressed and unstressed syllables. Utterance final pairs were omitted for this parameter.

Comparing speakers, they all use the correlates to a greater or lesser extent. The order is as follows (descending):

Duration: JF, AS, JG, LR

Voicing & aspiration: JG, LR, AS, JF (JG & LR very similar)

DPM: JG, AS, LR, JF (LR & JF very similar)

Fluctuation of dB: AS, JF, LR, JG.

Durational effects are largely on the second syllable, except for LR (Andalusian). Voicing and aspiration are used by the Spanish informants to a greater extent than the Latin-Americans. JG's pitch fluctuations are greater than all the others put together and sustained intensity is more typical of the Latin-Americans. However, averaging out all speakers' results, a possible model for this type of bisyllabic unit (Voiceless stop V, Voiceless stop V) would be the following, considering all the syllables together:

Basic syllable duration position 1 = 160 ms

(C = 60 ms, V = 100 ms)

Basic syllable duration position 2 = 170 ms

(C = 56.5 ms, V = 113.5 ms)

Stressed position 1 : decrease position 2 by 7%

(Increase C by 4%, decrease V by 19%)

Stressed position 2 : increase position 2 by 7%

(Decrease C by 4%, increase V by 19%)

Give C weak voicing for approximately first third closure

(if preceding segment voiced)

Give 'C very slight aspiration : approximately 2.5 ms

DPM onto or on 'V of 28 Hz

DPM onto or on V of 18 Hz

Fluctuation of intensity on 'V = 3.5 dB

Fluctuation of intensity on V = 8 dB

If the syllables are treated separately according to whether they are contained in non-utterance final words or utterance final words, the durational relationships are slightly different (Tables 17 and 18) although the other stress correlates do not change (dB in utterance final words was not included). Non-utterance final words are still longer when stressed on the second syllable than when stressed on the first and syllables in position 1 have approximately the same duration, whether stressed or unstressed. The consonant of the stressed syllable in position 2 however, is slightly longer than the consonant in unstressed position 2 for LR and JF, and slightly shorter for the other two speakers. The average is almost equal. A durational model for non-final words of this type would be the following:

Basic syllable duration position 1 = 153 ms

(C = 60 ms, V = 93 ms)

Basic syllable duration position 2 = 152 ms

(C = 52 ms, V = 100 ms)

Stressed position 1 : decrease position 2 by 9%

(decrease V by 15%)

Stressed position 2 : increase position 2 by 9%

(increase V by 14%)

The picture changes considerably in utterance final words. These words are of approximately the same duration for all speakers whichever syllable is stressed but pre-pausal lengthening is carried by both syllables when the syllable in position 1 is stressed, and only by the final syllable when position 2 is stressed. The releasing consonant of the final syllable increases its duration when the syllable is unstressed but remains approximately the same when it is stressed.

A suitable model for this type of word pairs in utterance final position would be the following:

['p a p a]

Prepausal lengthening = 90 ms

(30% of average duration of non-final word)

Increase stressed V by 8% of non-final word

Increase unstressed syllable by 22% of non-final word

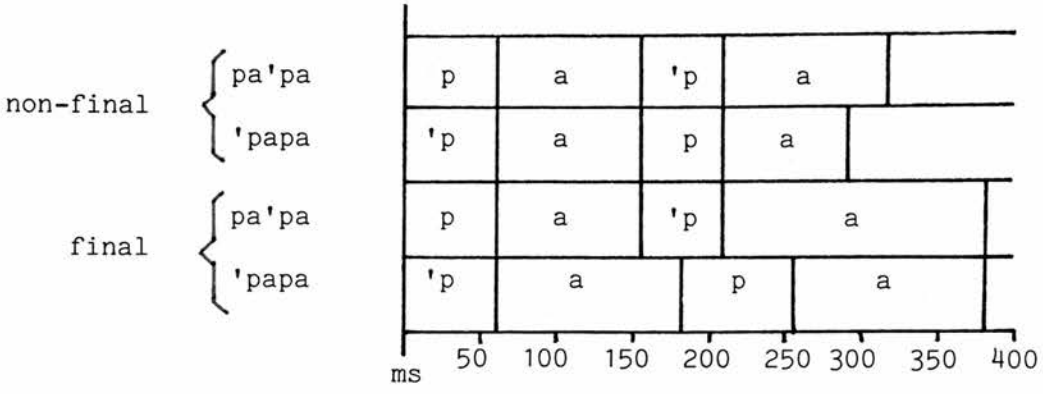
(C = 8%, V = 14%)

[p a 'p a]

Prepausal lengthening = 60 ms (20% of non-final word)

Increase stressed vowel by 20% of non-final word.

The following diagram should make this clearer:



The effect of pre-pausal lengthening therefore is greater when the word is stressed on the first syllable to when it is stressed on the second. The average difference between [p a 'p a] non-final and [p a 'p a] final is 90 ms or 24% of the whole word.

4. Results Set 2

Set 2 was designed principally to compare durations of stressed with unstressed syllables paradigmatically but the results can also be compared with the figures for Set 1 in which syllable and segmental durations were compared syntagmatically. Syllable and segmental durations of Set 1 are summarized in Table 16 and detailed figures of syllable durations for each speaker and all minimal pairs of Set 2 are contained in Tables 19 to 22.

The first column in Tables 19 to 22 refers to the numbers of the sentences in Set 2, so the figures along the first line are comparing "mi" in "ter'mino" with "mi" in "termi'no" in sentences 1 and 2 and

"no" with "'no". I decided to compare each syllable as a percentage of the bisyllabic unit in which it occurs, for the following two reasons. Firstly, the actual duration in milliseconds of stressed syllables in position 1 and unstressed syllables in position 1 was frequently almost identical and if duration is to function as a correlate of stress, the speaker must have some mean duration stored in long-term memory for that particular segmental sequence over or below which he will interpret a syllable as being stressed or unstressed respectively, all other things being equal. Secondly, each speaker varied quite considerably in tempo during his own recording and obviously a comparison of the actual durations in milliseconds of the syllable in question is not going to give a true picture if one member of the minimal pair lasts a total of 240 milliseconds and the other 400. Columns 3 and 4 give the exact durations of the syllable underlined in column 2 when it is, a) stressed and b) unstressed. Column 5 contains the figure in column 3 (i.e. duration of stressed syllable) as a percentage of the bisyllabic unit in which it is contained (i.e. column 3, position 1 plus column 4 position 2 or vice-versa). Column 6 contains the figure in column 4 (i.e. duration of unstressed syllable) as a percentage of the total of the figures in column 4 position 1, and column 3 position 2, or vice-versa. Column 7 contains the ratio of unstressed to stressed syllables as percentages, which is column 5 over column 6. Column 8 indicates ratios which are below the JND's quoted in Lehiste (1970) and reproduced here in Table 13. As these ratios do not corespond to any actual durations, the average of columns 3 and 4 has been taken as the figure on which to base the JND's. As this is rather complex, I will work through the first example:

	Position 1	Position 2
	(ter) 'mi	no
Duration ms	120 (Column 3)	115 (Column 4)
	(ter) mi	'no
Duration ms	100 (Column 4)	115 (Column 3)
% of bisyllabic unit	'mi = 51.1% (Column 5) $\left(\frac{120}{120 + 115} \times 100\right)$	'no = 53.5% (Column 5) $\left(\frac{115}{100 + 115} \times 100\right)$
% of bisyllabic unit	mi = 46.5% (Column 6) $\left(\frac{100}{100 + 115} \times 100\right)$	no = 48.9% (Column 6) $\left(\frac{115}{120 + 115} \times 100\right)$
Ratio unstressed to stressed	1 : 1.10 (Column 7) $\left(\frac{51.1}{46.5}\right)$	1: 1.09 (Column 7) $\left(\frac{53.5}{48.9}\right)$

If we compare the figures in actual milliseconds for Set 1 and Set 2 (Tables 16 to 22), the results are quite similar between all four speakers. Four constant factors emerge for each speaker:

(1) Stressed syllables are longer than unstressed syllables of identical segmental composition on average. (There are a few exceptions.)

(2) When the second syllable in a bisyllabic word is stressed, it is proportionately longer syntagmatically than when the first syllable is stressed.

(3) Vowels are longer than consonant closures in the 'Papa/pa'pa set and are on average longer than consonants in Set 2 (except for certain consonants, namely voiceless fricatives and affricatives which are extremely long).

(4) In Set 1, when the stressed vowel is in position 2, it is proportionately longer than the immediately preceding [p] syntagmatically than any other vowel is to the immediately preceding [p] in any other position.

The paradigmatic ratio stressed to unstressed when based on actual measurements shows a similar picture, e.g. for JG the ratio unstressed to stressed is 1 : 1.1 for position 1 and 1 : 1.5 for position 2. However, considering the syllable as a proportion of the bisyllabic unit in question and basing our ratios on these proportions gives us a very different picture.

Looking at JG's figures (Table 19), we find that the average ratio of unstressed to stressed syllables based on actual measurement for position 1 is 1 : 1.10, which is well below the JND for the absolute average syllable durations of 140.81 and 154.28 milliseconds. However, the ratio calculated paradigmatically on the basis of the syllables as a proportion of a bisyllabic unit gives an unstressed to stressed relationship of 1 : 1.19 (see column 7) which is just above the JND's in Table 13 (taking the average between stressed and unstressed as the time on which to base the JND). Looking at the figures for position 2 in Table 19, there is a very large difference between stressed and unstressed syllables if the ratio is based on actual length in milliseconds: 196.13 to 131 = 1.50 : 1. This is of course much greater than the JND's but when the ratio for position 2 is based on proportions, we find there is almost exactly the same ratio as for position 1, i.e. 1 : 1.21 (see column 7, Table 19).

This is an extremely interesting fact which holds good for all four speakers. It seems that it is not only the presence or absence of duration compared to overall word or utterance relative syllable

durations which serves to discriminate between stressed and unstressed syllables but a predetermined proportionate change stemming from a basic 'neutral' duration, according to whether the stress falls on the final syllable or the penultimate syllable within the word. Each word and the ratio stressed to unstressed will vary of course, depending on the segmental composition of the syllable and to a certain extent, position in utterance. Utterance final lengthening seemed to reduce the difference between stressed and unstressed for JG, LR and JF on the whole and have the opposite effect for AS. The only speaker whose ratios are below the JND's is speaker LR (Andalusian). If the durational differences are not noticeable perceptually then even though the results would be significant statistically (the stressed syllable twice has the value of less than 1), it would not be acceptable to rely on statistical evidence which would conflict with perceptual evidence. This is treated more thoroughly, and statistical tests applied in Chapters V and VI. It is possible that the native language of the listener affects the JND's for speech and a native Spanish speaker may be more sensitive to extra duration than a native English speaker, there being less variation in length of syllables in Spanish than English (Pointon, 1978). Berinstein however, found the opposite - that English-speaking listeners judged syllables to be stressed with smaller increases in duration than those needed for Spanish-speaking listeners from Guatemala to judge them as stressed. Of course, she did not ask whether the increases in duration had been perceived or not, only whether the syllables were perceived as stressed. Lehiste does not say what the native languages of the subjects were in the experiments on JND's.

The ratios stressed to unstressed in the sentences where an extra syllable was added, N°s 20, 22 and 25, were not affected.

Table 23 is a summary of the results in Tables 19 to 22 and the small graph which is the ratio stressed/unstressed plotted on the vertical axis against the average syllable length on the horizontal, shows that the longer the syllables are, the greater the ratio is likely to be. I have not been able to find any comparable studies for Spanish or English using this method.

5. Conclusion

The experiment has shown that there are four major stress differentiating parameters in Spanish: intensity, duration, voicing, and pitch, and that these often overlap. It is debatable whether pitch can be considered a true correlate of stress in the same category as the other three parameters as its use will depend to a large extent on the overall intonation contour. According to the results of both experiments, it is difficult to say which is the most consistent feature associated with stress in Spanish. Releasing consonants of stressed syllables utterance-medial tend to have less voicing than releasing consonants of unstressed syllables and the amplitude of the voicing of the vowel in stressed syllables is more constant throughout than in unstressed. Differences in duration seem to function paradigmatically as well as syntagmatically. Word-final stressed syllables are longer proportionately than the corresponding preceding stressed syllables in words of identical segmental composition whose meaning changes according to word accent. The paradigmatic durational ratios of stressed to unstressed syllables when calculated as percentages of the bisyllabic unit in which they occur are almost equal for the same speaker in both positions. Possible breakdowns in this fine temporal balance may be worthy of further study. Where the ratios stand out as being greater than usual (see Tables 19 to 22), the syllables in question were certainly heard as being over stressed.

It is clear that there is much scope for further research in this area and carefully planned perceptual experiments would need to be carried out. Voicing and sustained intensity are two parameters which need to be included with pitch, higher intensity and duration for Spanish. As the principal topic of this thesis is rhythm, a development of this section will have to be left to a later date.

TABLE 16

Stress Correlates in Spanish

average durations and ratios

Set 1 'Papa/pa'pa

Average Durations for Each Speaker

Utterance final and non-final

Set 1 'Papa/pa'pa (ms)

	'p	a	p	a		p	a	'p	a
JG	54	95	48	86	segment	50	100	39	138
	149		134		syllable	150		177	
	283				word	327			
LR	53	94	61	80		50	75	41	105
	147		141			125		146	
	288					271			
AS	72	121	57	115		67	107	65	149
	193		172			174		214	
	365					388			
JF	66	100	68	87		63	119	72	146
	166		155			172		218	
	321					390			
All Speakers	61	103	59	92		58	100	54	135
	164		151			158		189	
	315					347			

Average Ratios for Each Speaker (Syntagmatic)

	'p	a	p	a		p	a	'p	a
JG	1	2.76	1	2.77	C to V	1	2.99	1	4.60
	1.12		1		Uns. syl. to Str.	1		1.16	
LR	1	2.78	1	2.31		1	2.55	1	3.60
	1.04		1			1		1.17	
AS	1	2.70	1	3.04		1	2.57	1	3.28
	1.12		1			1		1.24	
JF	1	2.50	1	2.29		1	2.72	1	3.01
	1.07		1			1		1.26	

TABLE 17

Stress Correlates in Spanish

Set 1 'Papa/pa'pa

Average durations in ms (rounded off) : utterance non-final

	'p	a	p	a	p	a	'p	a
JG	51	93	44	74	44	87	39	107
	145		118		130		145	
	263				275			
LR	53	86	41	79	63	77	43	102
	139		120		140		148	
	259				288			
AS	74	107	62	104	58	119	60	124
	181		166		177		183	
	347				360			
JF	64	93	53	84	67	87	73	122
	157		138		154		195	
	295				349			
All Speakers	61	95	50	85	58	92	54	114
	156		135		150		168	
	291				318			

TABLE 18

Stress Correlates in Spanish

Set 1 'Papa/pa'pa

Average durations in ms (rounded off) : utterance final

	'p	a	p	a		p	a	'p	a	
JG	60	97	64	158	375	51	89	39	211	388
	157		222			139		249		
LR	52	113	67	70	292	56	87	36	119	299
	165		137			143		156		
AS	67	151	80	110	410	55	108	79	160	401
	220		190			162		239		
JF	72	113	86	164	435	71	86	71	197	425
	185		250			157		268		
All Speakers	62	119	74	126	381	58	93	56	172	378
	181		200			150		228		

TABLE 19

Stress Correlates in Spanish : Paradigmatic Analysis of Syllable Durations. JG. Set 2

Position 1								Position 2							
1 N° of sentence	2 syl	3 S pos1 ms	4 US pos1 ms	5 S pos1 % of 2 syl.	6 US pos1 % of 2 syl.	7 Ratio US to S	8 Ratios below J.N.D.	1 N° of sentence	2 syl	3 S pos2 ms	4 US pos2 ms	5 S pos2 % of 2 syl.	6 US pos2 % of 2 syl.	7 Ratio US to S	8 Ratios below J.N.D.
1 & 2	termino	120	100	51.1	46.5	1:1.10	+	1 & 2	termino	115	115	53.5	48.9	1:1.09	+
3 & 4	termino	150	140	43.6	45.2	1:0.96	+	3 & 4	termino	170	194	54.8	56.4	1:0.97	+
5 & 6	cantara	130	107	61.9	45.5	1:1.36		5 & 6	cantara	128	80	54.5	38.1	1:1.43	
7 & 8	cantara	155	105	45.6	34.1	1:1.31		7 & 8	cantara	203	185	65.9	54.4	1:1.21	
9 & 10	chupo	166	140	65.1	50.0	1:1.30		9 & 10	chupo	140	89	50.0	35.0	1:1.43	
11 & 12	chupo	161	140	43.5	37.8	1:1.15	+	11 & 12	chupo	230	209	62.2	56.5	1:1.10	+
13 & 14	rezo	194	176	62.6	50.0	1:1.25		13 & 14	rezo	177	116	50.1	37.4	1:1.34	
15 & 16	pillo	143	180	53.0	56.3	1:0.94	+	15 & 16	pillo	140	127	43.8	47.0	1:0.93	+
17 & 18	encua derno	155	120	66.0	43.2	1:1.53		17 & 18	encua derno	158	80	56.8	34.0	1:1.67	
19 & 20	bebe	130	140	62.0	50.0	1:1.24		19 & 20	bebe	140	80	50.0	38.1	1:1.31	
21 & 22	papa	165	125	57.1	41.7	1:1.37		21 & 22	papa	175	124	58.3	42.9	1:1.36	
23 & 24	saco	184	220	58.4	57.1	1:1.02	+	23 & 24	saco	165	131	42.9	41.6	1:1.03	+
23 & 25	saco	184	200	58.4	54.1	1:1.08	+	23 & 25	saco	170	131	45.9	41.6	1:1.10	+
26 & 27	bajo	111	100	41.4	35.7	1:1.16	+	26 & 27	bajo	180	157	64.3	58.6	1:1.10	+
28 & 29	toma	170	110	53.1	42.3	1:1.26		28 & 29	toma	150	150	57.7	46.9	1:1.23	
28 & 29	-mate	150	150	60.0	50.0	1:1.08	+	28 & 29	-mate	150	128	50.0	46.0	1:1.09	+
Average		154.25	140.81			1:1.19				196.13	131			1:1.21	
Ratio of ms		1.10:1								1.50:1					

syl = syllable; S = stressed; US = unstressed; pos = position; ms = milliseconds.

TABLE 20

Stress Correlates in Spanish : Paradigmatic Analysis of Syllable Durations. LR. Set 2

Position 1								Position 2							
1 N° of sentence	2 syl	3 S pos1 ms	4 US pos1 ms	5 S pos1 % of 2 syl.	6 US pos1 % of 2 syl.	7 Ratio US to S	8 Ratios below J.N.D.	1 N° of sentence	2 syl	3 S pos2 ms	4 US pos2 ms	5 S pos2 % of 2 syl.	6 US pos2 % of 2 syl.	7 Ratio US to S	8 Ratios below J.N.D.
1 & 2	termino	130	110	59.6	47.8	1:1.25		1 & 2	termino	120	88	52.2	40.4	1:1.29	
3 & 4	termino	130	110	54.3	45.5	1:1.19		3 & 4	termino	132	111	54.5	46.1	1:1.18	+
5 & 6	cantara	103	100	54.8	48.1	1:1.14	+	5 & 6	cantara	108	85	51.9	45.2	1:1.15	+
7 & 8	cantara	163	123	63.9	56.9	1:1.12	+	7 & 8	cantara	93	92	43.1	36.1	1:1.19	
9 & 10	chupo	150	178	57.7	52.4	1:1.10	+	9 & 10	chupo	162	110	47.6	42.3	1:1.25	
11 & 12	chupo	190	160	61.3	59.9	1:1.02	+	11 & 12	chupo	107	120	40.1	38.7	1:1.04	+
13 & 14	rezo	212	128	56.7	33.3	1:1.70		13 & 14	rezo	256	162	66.6	43.3	1:1.54	
15 & 16	pillo	158	158	55.2	52.0	1:1.06	+	15 & 16	pillo	146	128	48.0	44.8	1:1.07	+
17 & 18	encua							17 & 18	encua						
	derno	110	130	44.0	40.6	1:1.08	+		derno	190	140	59.4	56.0	1:1.06	+
19 & 20	bebe	131	109	51.4	39.1	1:1.31		19 & 20	bebe	170	124	60.9	48.6	1:1.25	
21 & 22	papa	140	134	56.0	49.4	1:1.13		21 & 22	papa	137	110	50.6	44.0	1:1.15	+
23 & 24	saco	170	165	54.7	48.5	1:1.13	+	23 & 24	saco	175	141	51.5	45.3	1:1.14	+
23 & 25	saco	170	153	54.7	51.0	1:1.07	+	23 & 25	saco	147	141	49.0	45.3	1:1.08	+
26 & 27	bajo	125	127	47.3	47.4	1:1.00	+	26 & 27	bajo	141	139	52.6	52.6	1:1.0	+
28 & 29	toma	123	113	45.1	46.1	1:0.98	+	28 & 29	toma	132	150	53.9	55.0	1:0.98	+
28 & 29	-mate	132	135	51.4	47.4	1:1.08	+	28 & 29	-mate	150	125	52.6	48.6	1:1.08	+
Average		146.1	133.3			1:1.15				147.9	122.9			1:1.15	
Ratio of ms		1.09:1								1.2:1					

syl = syllable; S = stressed; US = unstressed; pos = position; ms = milliseconds.

TABLE 21

Stress Correlates in Spanish : Paradigmatic Analysis of Syllable Durations. AS. Set 2

Position 1								Position 2							
1 N° of sentence	2 syl	3 S pos1 ms	4 US pos1 ms	5 S pos1 % of 2 syl.	6 US pos1 % of 2 syl.	7 Ratio US to S	8 Ratios below J.N.D.	1 N° of sentence	2 syl	3 S pos2 ms	4 US pos2 ms	5 S pos2 % of 2 syl.	6 US pos2 % of 2 syl.	7 Ratio US to S	8 Ratios below J.N.D.
1 & 2	termino	143	110	50.5	36.9	1:1.37		1 & 2	termino	188	140	63.1	49.5	1:1.27	
3 & 4	termino	207	140	58.3	39.7	1:1.50		3 & 4	termino	213	148	60.3	41.7	1:1.47	
5 & 6	cantara	133	104	51.2	43.0	1:1.19		5 & 6	cantara	138	127	57.0	48.8	1:1.17	+
7 & 8	cantara	231	163	65.1	47.9	1:1.36		7 & 8	cantara	177	124	52.1	34.9	1:1.49	
9 & 10	chupo	186	180	60.4	50.6	1:1.19		9 & 10	chupo	176	122	49.4	39.6	1:1.25	
11 & 12	chupo	215	185	50.0	45.5	1:1.10	+	11 & 12	chupo	222	215	54.5	50.0	1:1.09	+
13 & 14	rezo	180	163	52.2	35.4	1:1.47		13 & 14	rezo	297	165	64.6	47.8	1:1.35	
15 & 16	pillo	185	200	52.1	49.5	1:1.05	+	15 & 16	pillo	204	170	50.5	47.9	1:1.05	+
17 & 18	encua							17 & 18	encua						
	derno	146	160	55.1	44.9	1:1.23			derno	196	119	55.1	44.9	1:1.23	
19 & 20	bebe	116	156	51.6	52.7	1:0.98	+	19 & 20	bebe	140	109	47.3	48.4	1:0.98	+
21 & 22	papa	184	160	58.6	45.7	1:1.28		21 & 22	papa	190	130	54.2	41.4	1:1.31	
23 & 24	saco	175	180	54.7	46.4	1:1.18		23 & 24	saco	208	145	53.6	45.3	1:1.18	
23 & 25	saco	175	182	54.7	49.2	1:1.11	+	23 & 25	saco	188	145	50.8	45.3	1:1.12	+
26 & 27	bajo	158	172	50.2	43.3	1:1.16	+	26 & 27	bajo	225	157	56.7	49.9	1:1.14	+
28 & 29	toma	250	120	63.6	35.6	1:1.79		28 & 29	toma	217	143	64.4	36.4	1:1.77	
28 & 29	-mate	217	143	62.5	47.7	1:1.37		28 & 29	-mate	170	130	53.5	37.5	1:1.43	
Average		181.3	157.4			1:1.27				196.8	143.1			1:1.27	
Ratio of ms		1.15:1								1.38:1					

syl = syllable; S = stressed; US = unstressed; pos = position; ms = milliseconds.

TABLE 22

Stress Correlates in Spanish : Paradigmatic Analysis of Syllable Durations. JF. Set 2

Position 1								Position 2							
1 N° of sentence	2 syl	3 S pos1 ms	4 US pos1 ms	5 S pos1 % of 2 syl.	6 US pos1 % of 2 syl.	7 Ratio US to S	8 Ratios below J.N.D.	1 N° of sentence	2 syl	3 S pos2 ms	4 US pos2 ms	5 S pos2 % of 2 syl.	6 US pos2 % of 2 syl.	7 Ratio US to S	8 Ratios below J.N.D.
1 & 2	termino	117	138	47.4	47.8	1:0.99	+	1 & 2	termino	151	130	52.2	52.6	1:0.99	+
3 & 4	termino	153	124	43.2	34.4	1:1.26		3 & 4	termino	236	201	65.6	56.8	1:1.15	+
5 & 6	cantara	160	125	66.1	45.0	1:1.47		5 & 6	cantara	153	82	55.0	33.8	1:1.63	
7 & 8	cantara	234	141	60.0	39.5	1:1.52		7 & 8	cantara	216	156	60.5	40.0	1:1.51	
9 & 10	chupo	222	167	60.8	42.6	1:1.43		9 & 10	chupo	225	143	57.4	39.2	1:1.46	
11 & 12	chupo	207	157	49.6	40.9	1:1.21		11 & 12	chupo	227	210	59.1	50.4	1:1.17	+
13 & 14	rezo	229	174	60.7	42.9	1:1.41		13 & 14	rezo	232	148	57.1	39.3	1:1.45	
15 & 16	pillo	216	214	62.2	58.3	1:1.07	+	15 & 16	pillo	153	131	41.7	37.8	1:1.10	+
17 & 18	encua							17 & 18	encua						
	derno	146	150	54.7	45.3	1:1.21			derno	181	121	54.7	45.3	1:1.20	
19 & 20	bebe	135	140	57.0	43.8	1:1.30		19 & 20	bebe	180	102	56.3	43.0	1:1.31	
21 & 22	papa	170	159	51.2	58.2	1:0.88	+	21 & 22	papa	114	162	41.8	48.8	1:0.86	+
23 & 24	saco	209	179	54.3	47.5	1:1.14	+	23 & 24	saco	198	176	52.5	45.7	1:1.15	+
23 & 25	saco	209	153	54.3	44.9	1:1.21		23 & 25	saco	188	176	55.1	45.7	1:1.21	
26 & 27	bajo	135	122	55.1	39.4	1:1.40		26 & 27	bajo	188	110	60.6	44.9	1:1.35	
28 & 29	toma	129	140	48.1	49.6	1:0.97	+	28 & 29	toma	142	139	50.3	51.9	1:0.97	+
28 & 29	-mate	142	139	52.4	46.3	1:1.13	+	28 & 29	-mate	161	129	53.7	47.6	1:1.13	+
Average		175.8	151.4			1:1.23				184.1	144.75			1:1.23	
Ratio of ms		1.16:1								1.27:1					

syl = syllable; S = stressed; US = unstressed; pos = position; ms = milliseconds.

TABLE 23

Stress Correlates in Spanish

Average durations in milliseconds and average ratios for each speaker, Set 2

Summary of Tables 19 to 22

Speaker	Average Position 1	Pos. 1 Ratio Str/Unstr.	Average Position 2	Pos. 2 Ratio Str/Unstr.
JG	147.53	1:1.19	163.56	1:1.21
LR	139.7	1:1.15	135.4	1:1.15
AS	169.35	1:1.27	169.95	1:1.27
JF	163.6	1:1.23	164.4	1:1.23

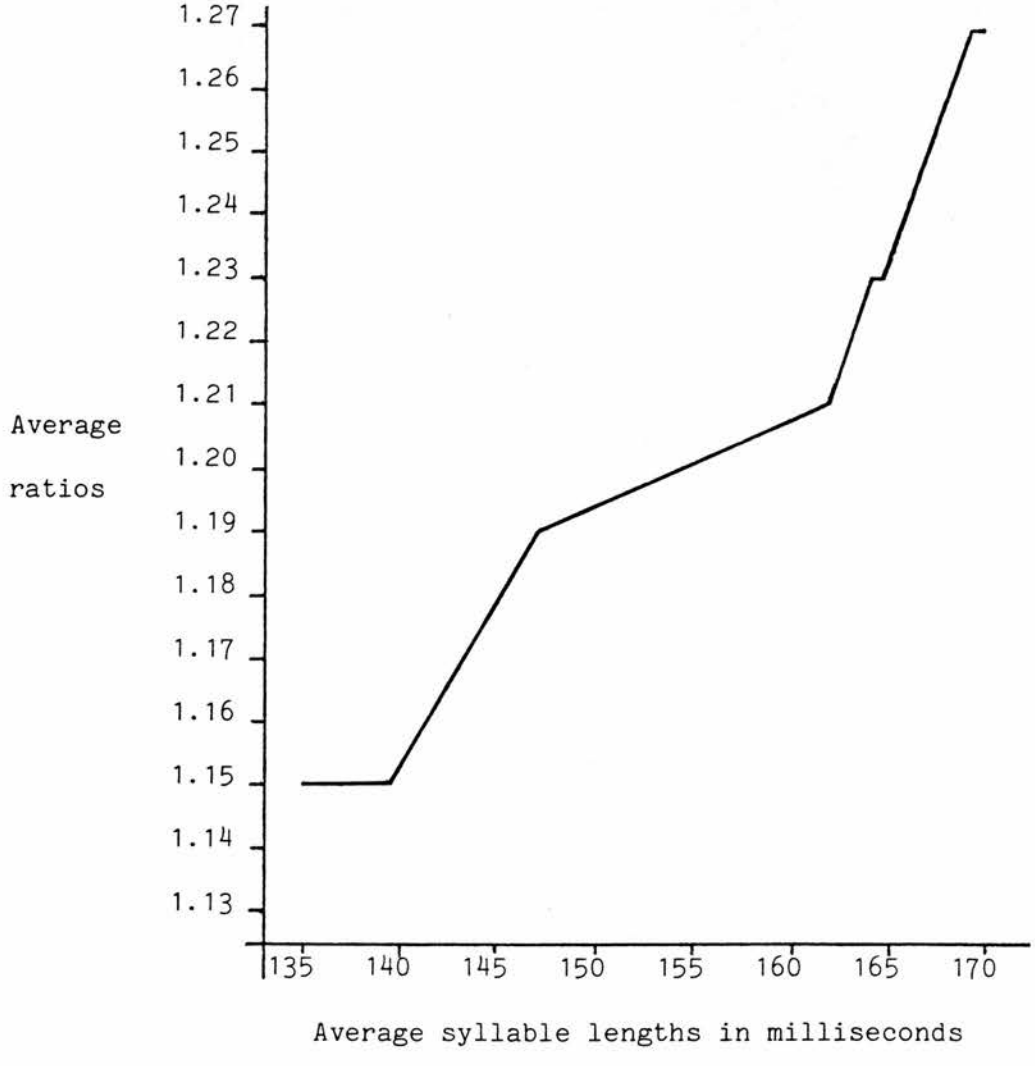


TABLE 24

Stress Correlates in Spanish
averaged for each speaker,
Set 1, 'Papa/pa'pa

		Syllable Duration in ms		Voicing of /p/ 0-1		Aspiration of /p/ ms		DPM Hz		Fluctuation of dB*	
				Stress		Stress		Stress		Stress	
		Pos. 1	Pos. 2	+	-	+	-	+	-	+	-
JG Castille	Basic	149	156	0.19	0.42	3.3	0.8	37.3	16.5	4.3	6.8
	Stress 1		-14%								
	Stress 2		+14%								
LR Andalusia	Basic	136	144	0.15	0.45	3.2	0.9	20.4	16.5	3.8	6.9
	Stress 1	+8%	-2%								
	Stress 2	-8%	+2%								
AS Venezuela	Basic	184	193	0.07	0.22	1.9	0.7	40.2	28.3	4.1	12.7
	Stress 1	+5%	-11%								
	Stress 2	-11%	+5%								
JF Mexico	Basic	169	187	0.04	0.22	1.81	0.96	15.6	12.7	2.1	6.7
	Stress 1		-17%								
	Stress 2		+17%								

*omitting finals.

CHAPTER V

A COMPARISON OF SYLLABLE AND STRESS GROUP DURATION IN ENGLISH, FRENCH AND SPANISH

1. Introduction

In chapter III an experiment was carried out to find out whether languages could be identified from their prosodic features alone and whether an analysis of listeners' errors of judgement would throw any light on the nature of the rhythmic structure of Spanish prose. It was found that listeners confused Spanish and French to a much greater extent than English and French, or English and Spanish, which would indicate that the rhythm of Spanish has more in common with that of French than that of English. Spanish was however the most successfully identified language and so there must obviously be important rhythmic differences between French and Spanish. English has established itself quite firmly as a stress-timed language (although objective isochrony between stresses does not exist) and although French is considered to be syllable-timed by some and not by others (cf. Chapter I), the characteristics of syllable-timing and stress-timing have been used as starting points in this instrumental study. These characteristics are as follows:

	Syllable-timed languages		Stress-timed languages
1.1	The Syllable		
1.1.1	Syllable Duration		
1.1.1.a)	Syllables tend to be nearly equal in duration (Abercrombie, 1967 : 98).	a)	There is considerable variation in syllable duration (Abercrombie, 1967 : 98).
1.1.1.b)	Syllable duration does not vary according to the number of syllables in the stress group.	b)	Syllable duration varies according to the number of syllables in the rhythmic unit to which they belong, syllables are shorter in feet (stress groups) containing more syllables (Pike, 1945 : 34).
1.1.1.c)	The duration of a stressed vowel will not change, no matter how many unstressed syllables precede or follow it.	c)	The duration of a stressed vowel is longest in a monosyllabic foot, and the greater the number of following unstressed syllables, the shorter the stressed vowel (Jones, 1960 : 237).

1.1.1.d) If syllables follow each other at regular intervals, an increase in duration on the stressed syllable would upset syllabic isochrony. One would therefore expect other features to be used as correlates.

d) Duration may be used as an important differentiating correlate for stressed syllables as syllables may vary in length without affecting the overall duration of the stress group.

1.1.2 Syllable Structure

1.1.2.a) Simple CV syllables are preferred (Smith, 1976 : 107).

a) A variety of syllable structures, including complex consonant clusters may be found.

1.1.2.b) There should be no difference in the distribution of syllable structure between stressed and unstressed syllables.

b) In English, "heavier" syllables (containing 4 or more segments) are more frequently stressed, and light syllables (containing 1 or 2 segments) are more frequently unstressed; when an unstressed syllable is added to a foot, it is often merely the addition of a vowel or syllabic consonant (Dauer, 1980 : 361).

1.1.3 Segmental Modification

1.1.3.a) Syllables and vowels are less likely to be shortened and modified: each unstressed syllable is sharp-cut (Pike, 1945:35).

a) Unstressed vowels may be obscured and unstressed syllables omitted (Pike, 1945:34).

1.1.3.b) Consonants may be obscured or omitted especially in more complex syllable structures in order to preserve a simple CV pattern.

b) Elision of consonants is less likely to occur. Clusters tend to be retained.

1.1.4 Rate of Syllable Succession

1.1.4.a) Syllables tend to recur at approximately equal intervals, the rate of syllable succession is constant (Abercrombie, 1967 : 97-98).

a) The rate of syllable succession varies (Abercrombie, 1965 : 18); syllables are crushed together and pronounced very rapidly in rhythmic units containing more and more syllables (Pike, 1945 : 34).

1.2 The Stress Group

1.2.1 Interstress Intervals

1.2.1.a) Stress separated by different numbers of unstressed syllables will be separated by different intervals of time (Abercrombie, 1967: 98).

a) There is a strong tendency for stressed syllables to follow each other at equal distances (Jones, 1960 : 237), there is a periodic recurrence of stress pulses (Abercrombie, 1967 : 97).

1.2.1.b) Phrases with extra syllables take proportionately more time (Pike, 1945: 35); the duration of the rhythmic group is proportional to the number of syllables and grammatical cuts in the group (Classe, 1939 : 86).	b) The ratio of successive average foot durations does not depend merely on the number of syllables in the foot (Catford, 1977 : 86-7).
1.2.1.c) There is a wide variation in interstress intervals.	c) In English, there is a preponderance of interstress intervals in the narrow range 40-70 cs (Abe, 1967, in Allen, 1975 : 77).

1.2.2 Frequency of occurrence of stress groups

No specific preference for stress groups containing a particular number of syllables.	There should be a high proportion of stress groups containing the same number of syllables.

1.2.3 Pre-pausal lengthening

In syllable-timed languages, pre-pausal lengthening may be shorter than in stress-timed.

1.2.4 Position of stressed syllables in speech continuum

In English there is a tendency to avoid having stresses too close together: the position of stress varies in some words; stresses may occur on alternate words in a sentence; accented syllables may be unstressed (Ladefoged, 1975:102-3).

The above tabulation is based on Dauer (1980 : 360-362) with certain modifications. Any characteristics without references are my own observations.

2. Method

2.1 Design

In order to classify Spanish according to the above characteristics, the instrumental data obtained from recordings of English, French and Spanish prose were segmented and examined (cf. Procedure). Unless otherwise stated, the measurements were taken from internal stress

groups only for the leader-timed analyses and internal and post-pausal for the trailer-timed and word-timed analyses for French and Spanish (Sections 2.3.2.1, 2.3.3.1). The experimental steps taken are numbered according to the classification given in the introduction to this chapter for characteristics of stress-timed and syllable-timed languages.

2.1.1 The Syllable

2.1.1.1 Syllable Duration

2.1.1.1 a) All syllables including pre- and post-pausal were measured, and F tests for variance applied in order to compare variation in duration between languages.

2.1.1.1 b) Average durations of stressed and unstressed syllables according to the type of stress group they were contained in were compared for all languages. In the trailer-timed analysis of French and the word-group-timed analysis of Spanish, post-pausal stress groups were included in the data for internal groups as their average durations were found to be the same (approx. 10 ms less in French) as the average durations of other non-utterance final groups.

2.1.1.1 c) The durations of stressed vowels (syllable nuclei) were compared according to the number of syllables per stress group.

2.1.1.1 d) In order to compare the use of duration as a stress correlate between the languages, average durations and standard deviations of stressed and unstressed syllables according to the number of syllables per stress group were calculated.

2.1.1.1 Syllable Structure

2.1.1.2 a) The segmental structure of all syllables was examined and compared.

2.1.1.2 b) Syllable structure according to the position of the syllable within the stress group was examined and compared (all syllables).

2.1.1.3 Segmental Modification

2.1.1.3 a) The three texts were examined for vowel reduction or elision or other modification (all syllables).

2.1.1.3 b) The three texts were examined for consonant reduction or elision or other modification (all syllables).

2.1.1.4 Rate of Syllable Succession

The rate of syllable succession in general and according to the type of stress-group was compared (all syllables).

2.1.2 The Stress Group

2.1.2.1 Interstress Intervals

2.1.2.1 a) & b) Interstress intervals were measured and compared according to the number of unstressed syllables occurring in these intervals. Stress groups in which it was suspected that grammatical cuts might be influencing the rate of syllable succession were omitted. These included filled pauses.

2.1.2.2. c) F tests for variance were applied in order to compare variation in duration of interstress intervals.

2.1.2.2 Frequency of Occurrence of Stress Groups

The frequency of occurrence of stress group type according to the number of syllables they contained was compared in all languages.

2.1.2.3 Pre-Pausal Lengthening

Pre-pausal lengthening was measured and compared.

2.1.2.4 Position of Stressed Syllables in Speech Continuum

All texts were examined to find out whether stress on consecutive syllables is avoided, whether alternate words tend to be stressed and whether accented syllables are unstressed in some cases (all syllables).

2.2 Informants and Materials

The data used for these tests is the same passage, L'Arche de Noè, as that used for the experiments described in Chapter III. In a small pilot experiment, five native speakers of each language recorded the above text according to the procedure described below in 2.3. A part of each of these recordings was examined, the measurements obtained were averaged and the recording of the informant whose measurements were most typical, i.e. closest to the average durations of the five, was used in the experiment described in this chapter. It could be argued that an analysis of the speech of one informant cannot provide sufficient evidence on which to base any conclusions or generalizations concerning that language. However, the three informants used here are all standard speakers of their languages and as such have phonetic bases common to all other standard speakers, as was proved in the previous chapter where languages were identified from the speech of one informant. The English informant was an R.P. speaker, the French was from Rouen, Northern France, and the Spanish from Castille. It is believed that possible individual differences in the durations of the phonetic units to be examined in this chapter are of negligible importance when comparing different languages. No utterance can ever be exactly the same as another, even when said by the same person.

Moreover, a certain amount of data from other sources is available for the three languages and the comparable results are very similar to others as will be seen later. In this study, durational differences have been tested between five native speakers of Spanish from different regions (Chapters IV and VI) and only very slight differences were apparent, with the possible exception of a Mexican speaker.

2.3 Procedure

The passages were recorded under laboratory conditions, at a comfortable reading speed for each informant. The informants were allowed to look over the passage beforehand so that they would be able to read fluently, thereby avoiding hesitations and slips of the tongue which would have altered the rhythm and complicated the task of segmentation. The following instruments were used to provide the mingographic tracings from which the texts were segmented: microphone, obtaining the speech wave-form; intensity meter showing fluctuations in intensity; the laryngograph showing vocal fold vibrations; the pitch computer, showing variations in fundamental frequency; and the time marker. Each unit measured was given a durational value in milliseconds. The complete segmentation of all three texts is contained in Appendix 5.

In applying the tests, there were several difficulties to contend with, the principal one being the segmentation of the tracings representing the speech continuum into discrete units, i.e. segments, syllables and words, deciding which syllables were stressed and which unstressed, and which segments could be considered as syllable nuclei and which as marginal. On the whole, the native speaker's intuition was followed when deciding on stress placement, syllable and word

division. The following criteria were used:

2.3.1 English

2.3.1.1 Stress Group and Word Division

Stress groups have been divided according to traditional methodology. The stress group is taken to consist of one stressed syllable leading the group, plus any unstressed syllables up to but not including the following stressed syllable.

Each word has been taken to consist of one or more complete syllables. In cases where a word final consonant is followed by a word initial vowel, the consonant has been allotted to the first word, e.g. "let us" [lɛt ʌs] (Stress group N° 12). . Many word final [t]s tend to be glottalized, they have no aspiration and are often partially voiced if followed by a voiced segment. Word initial [t]s however are always completely voiceless and often aspirated, whether the syllable containing them is stressed or unstressed. The observation concerning voicing applies to all voiceless consonants in these contexts. Linking [r]s have not been possible to segment as a unit and word division has therefore been made at the point of least intensity. In cases of assimilation such as "is she" [ɪʃʃɪ] (Stress group N° 56), a geminate consonant is produced or at least a long one and this has been divided in half. There are very few occurrences in the sample.

2.3.1.2 Identification of Stressed Syllables

As the various parameters which function as stress correlates are different or differ hierarchically in different languages, native speakers were asked to listen to the tape and place stress markers over the syllables they considered to be stressed. Where these did not coincide, the decision of the majority was accepted. Where there was no majority, I made the final decision. The native speakers tended to mark as stressed, those syllables which would preserve the tendency

towards equal intervals between stresses, even though, on occasions, some other syllable in the group carried the stress correlates of English to the same degree.

2.3.1.3 Syllable Division

Syllables within words have been treated in the following way: CVCV words consist of two syllables CV/CV, except when the second C is [ŋ], CVCCV words consist of two syllables CVC/CV except in the case of CVC + [r, l, w, j] + V in which case the division is CV/CCV. Where it has not been possible to divide contiguous syllables such as "continued the" [kn̩'tinjʊ̈dðə] (Stress group N°s 101, 102), half the duration [dð] has been allotted to one syllable and half to the other. Where an approximant or voiced fricative occurs intervocalically, e.g. "not a" [nɒðə] (Stress group N° 190), there is sometimes no point of segmental division apparent from the wave-form and the syllables have been divided at the point of least intensity. On the whole, however, it has been possible to make a fairly precise syllable division. The speech wave-form contains typical patterns (which vary from person to person) according to the type of segment; nasals, stops, fricatives, approximants, and to a certain extent, vowels, which has made the segmentation of long stretches of voiced utterance possible. The tracing of the intensity meter was also helpful, there usually being a slight dip in the tracing between one syllable and the next. Durations of syllables of doubtful divisibility have been omitted from tests in which lack of precision could affect the results.

2.3.1.4 Segment Division and Syllable Nuclei

As mentioned above, it was normally possible to obtain segment durations from the instrumental tracings. Where this was not possible, the data has been omitted from the test dealing with syllable nuclei.

Aspiration following voiceless stops has been allotted to the stop duration.

Syllabic nasals and laterals have been considered as syllable nuclei.

[r, w, j] have been considered as syllable marginal when not combined in clusters and when voiceless. Otherwise they are considered as transitional elements and as they are indistinguishable from the following vowel, are included as part of the syllable nucleus, e.g. in "squirrels" [skwɪr̥lz] [wɪ] and [l] are nuclei, [r] is marginal, but the division had to be made at the point of least intensity as it was indistinguishable from [l] (Stress group N° 43). In "crocodile" [krɒkðaɪl], [r] was voiceless and therefore marginal (Stress group N° 173). These instances were few and as previously stated, dubious data were not used.

In some cases, syllable final nasals, especially in clusters, were indistinguishable from the preceding vowel, which was nasalized anyway, and were therefore considered as part of the syllable nucleus, e.g. "pounds" [pʰaω̃nz] (Stress group N° 105). Only four syllable nuclei of this type were used.

2.3.2 French

2.3.2.1 Stress Group and Word Division

According to Wenk and Wioland, the main difference between the rhythms of English and French is that English is "leader-timed", stressed syllables regulating the group initially and French "trailer-timed" in which stressed syllables regulate group finally (cf. Chapter I, pp25 - 26). The "Protensive Regulation Principle" accounts for the trailer-timing of standard French. "The Protensive Regulation Principle enshrines the data drawn from...objective rhythm studies and states that accented syllables characterized by relatively greater length but

not greater acoustic intensity than unaccented syllables will regulate group-finally" (Wenk and Wioland, 1982 : 205). They also claim that "French syllables are produced and perceived in rhythmic groups, just as those of English or, doubtless any language" (Wenk & Wioland, 1982: 214) and deny the existence of syllable-timing in French. This being so, one might expect a difference to emerge between analysing French as trailer-timed and as leader-timed and therefore both were done and compared.

As in English, each word has been taken to consist of one or more complete syllables, with the following exceptions:

a) where a vowel in a word of CV structure has been elided, the remaining consonant has been allotted to the previous word, e.g. "tout le monde" [tulmõd] (Stress group N° 5), "c'est ce que" [sɛskə] (Stress group N° 61), "vous me faites" [vumfɛt] (Stress group N° 129).

b) In "tu as" /y/ was realized as lip-rounding and palatalization on [t], forming one syllable [t͡ɥ a] (Stress group N° 91).

c) "vingt-quatre heures" was realized as [vɛ̃katRœR], [tR] being allotted to the third syllable (Stress group N° 155).

d) There were some examples of contiguous vowels at word boundaries combining into diphthongs as in Spanish, e.g. "songeait a part" [sõʒɛapaR] (Stress group N°s 67, 68).

e) In the cases of liaisons, the duration of the consonant was divided between the two words involved, e.g. "mes amis" [mezami] (Stress group N° 8), "se fut un éclat" [səfytœ̃] (Stress group N°s 120-1). The reason for this was simply that I feel the consonant is acting as syllable divider and

is not assignable to either one. Several native speakers were consulted on this point and their opinions differed. There were 12 examples of liaisons in the text examined out of a total of 436 syllables. The consonants involved were short.

2.3.2.2 Identification of Stressed Syllables

Native speakers were asked to listen to the tape and place stress markers over the syllables they considered to be stressed. Unfortunately they tended to mark as stressed those syllables they would have given more prominence to had they been reading the passage. In general word final syllables were stressed and an increase in duration seemed to be the most important determining factor. These syllables also contained a long releasing consonant. Wenk and Wioland distinguished between emphasis and accent (stress) and my informant marked as stressed those syllables which he had emphasized. According to Wenk and Wioland, "one means of emphasizing a lexical item in French involves increments in fundamental frequency, intensity and duration that recall the phonetic reflexes of stress in English" and continue to say that "it can affect any lexical word regardless of its position in the sense-group" (Wenk and Wioland, 1982 : 198) (and presumably any syllable of that word). They argue for the need to treat emphasis and accentual (stress) phenomena separately. However, as the informant marked the emphasized syllables as stressed, as well as the stressed, e.g. "absolument" [absɔlymã] (Stress group N°s 70, 71) in which [sɔ] was emphasized and [mã] stressed, these were considered as belonging to two different stress groups. In other cases, the emphasized syllable took precedence over the potentially stressed, taking the place, so to speak, of the syllable which would normally have been stressed, e.g. "condamnés" [kõδane] (Stress group N°s 27, 28) in which

[kõ] was heard as more prominent (see also groups 51, 58, 62, 77, 96). Words such as "maître", "exemple" were stressed on the penultimate syllable when the final [ə] was pronounced, thus forming an extra syllable, ['mɛtRədə], [ɛg'zɑ̃(ᵐ)plədə]. This occurred when the following word began with a consonant.

2.3.2.3 Syllable Division

The same basic procedure was used as for English. The majority of the syllables (60.6%) were of CV structure, thus providing obvious syllable dividers and nuclei. The informant avoided abutting stop consonants, e.g. "cette pluie" formed three syllables [sɛtəplɥi] (Stress group N° 149). In the case of two consecutive vowels, eg. "un intérêt" [œ̃ ɛ̃teRɛ] (Stress group N° 32), two definite peaks are usually apparent in the speech wave-form and the intensity tracing, which correspond to two tongue movements and the division has been made at the point which shows least intensity.

2.3.2.4 Segment Division and Syllable Nuclei

As for English, where it was not possible to obtain segment durations from the instrumental tracings, the data was omitted from the test dealing with syllable nuclei. Any delay in voice onset following voiceless stops was allotted to the vowel duration. This was not frequent and in all cases very short. The approximants [ɥ, w, j] were usually indivisible from the following vowel and treated as part of the syllable nucleus, e.g. "poursuivit" [puRsɥivi], "viande" [vjɑ̃də], "pourquoi" [puRkwa]. /R/ was also indivisible from its adjacent vowel when it was realized as an approximant. It was however, usually realized as a fricative, never a trill, and when followed by a voiceless stop, invariably a voiceless fricative. There were 27 instances of these approximants in internal stress groups in the French recording. They were used when comparing the variation in

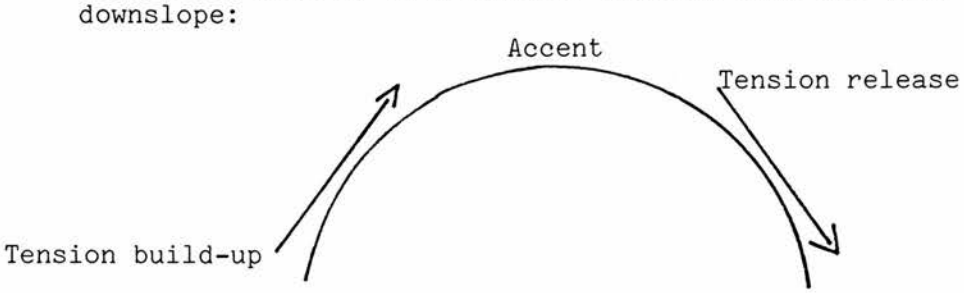
duration of nuclei of stressed syllables, as in English and Spanish (Table 31, Figure 31) but not when comparing vowel duration of the unstressed vowels of similar quality (Table 38).

2.3.3 Spanish

2.3.3.1 Stress Group and Word Division

The Spanish text was divided into stress groups by two different methods and these were compared. The first analysis was carried out as for English, considering the stressed syllable as leading the group which included any unstressed syllables following it up to but not including the following stressed syllable. This method, however, could be considered as unsuitable for Spanish as the majority of words are stressed on the penultimate syllable. Nor can it be considered as trailer-timed like French as few words are stressed on the final syllable, so using either type of analysis the majority of content word boundaries would not coincide with stress group boundaries. According to Wenk and Wioland, the

> "...rhythmic patterns in speech, to the extent that they correspond to muscular events, involve successive phases of tension and relaxation. This may be visualized in terms of a stylized rhythm curve whose upslope, preceding the accent, would involve relatively greater articulatory tension than the post- accentual downslope:



Stylized rhythm curve

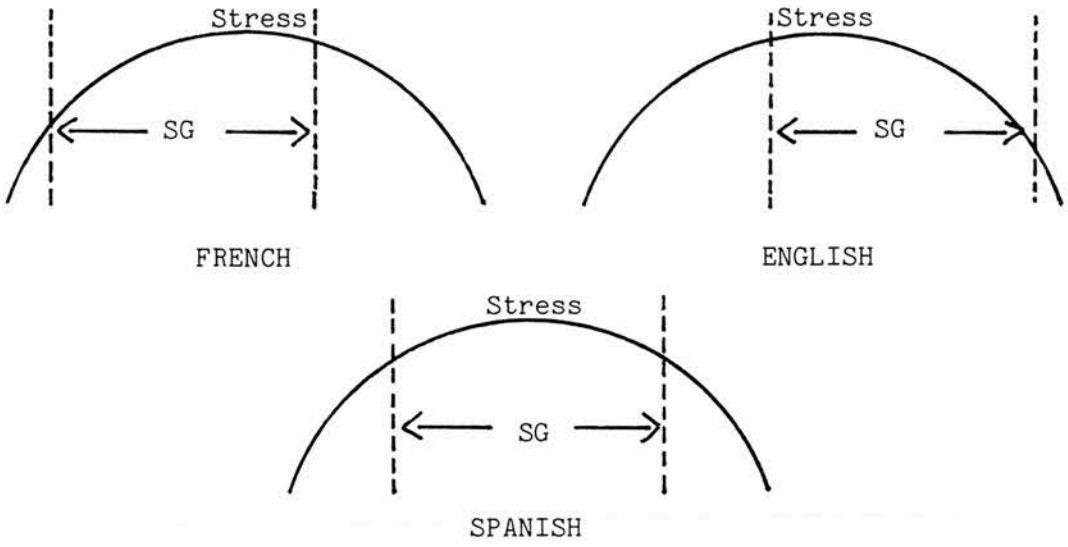
> It is natural to locate rhythmic accent on the peak of the curve because, regardless of whatever other feature might variably accompany accented syllables, explicitness of articulation (Brown, 1977 : 46) requiring maximal outlay of articulator energy, invariably marks such syllables. In terms of a leader-

> timed language, whose accented syllables generally involve an intensity increment, the intensity maxima should also correspond to the rhythmic peaks designated above. In other words, intensity and rhythm curves in leader-timing may be expected to be in phase. However, in trailer-timing greater intensity is more likely to be found on group initial than on group final syllaables. As a result, intensity and rhythm curves in trailer-timing are out of phase. Because of their position on the upslope (tension build-up) of the rhythm curve, unaccented trailer-timed syllables display a greater degree of muscular tension than their leader-timed counterparts, which fall on the post-accentual downslope of the curve" (Wenk and Wioland, 1982 : 205).

They argue therefore that pre-tonic (or unstressed) vowels in a trailer-timed language will be characterized by explicitness of articulation as they coincide with the tension build-up slope whereas unstressed vowels in a leader-timed language will suffer modification due to their position on the tension release slope. This is backed up by data from 21 native French speakers, intermediate learners of English who produced significantly more reduced vowels in the post-tonic (post-stressed) position when reading a text which they had heard read by a native speaker of English immediately beforehand (Wenk and Wioland, 1982 : 209). Although a controlled experiment has not been carried out, this coincides with observations of Spanish-speaking intermediate learners of English, who will usually pronounce "telephone" ['tɛlə͡fɒn] but "telephonic" [tɛlɛ'fɒnɪk]. Vowels which may be slightly centralized in Spanish also tend to occur on post-stressed syllables within the word. The nearest approximation to an English type schwa is heard in final syllables, particularly containing /a/ in words like "patata, cocina" (potato, kitchen), etc.

According to the above theory, the stressed syllable in Spanish falls approximately at the peak of the rhythm curve, there being an average of 2.9 syllables per stress group, and a language-specific preference for stressing the penultimate syllable of words. Plotting the stress group on the stylized rhythm curve, the three languages would occupy

different positions:



SG = Stress Group

The second analysis of Spanish which will be referred to as Word-group-timing, was carried out therefore according to the following syntactic criteria:

a) Each stress group contains one stressed syllable.

b) Each stress group contains one or more complete words (except adverbs).

c) Prepositions are allotted to the following noun or verb.

d) Relative pronouns are allotted to the following noun or verb.

e) Conjunctions are allotted to the following word.

f) Definite and indefinite pronouns are allotted to the following noun.

g) Where a word contains two stressed syllables, it is split at the morpheme boundary (adverbs).

h) Where sinalefa occurs, the resulting syllable is allotted to the preceding word.

This coincides with Navarro Tomás' division into stress groups which he calls "minimal fraction of speech with definite semantic value" and gives the following example: 'El poeta - exhibe - su corazon - con la jactancia - del burgués -enriquecido - que ostenta - sus palacios' (Navarro Tomás, 1968 : 58-59) (cf Chapter I, p. 33).

As with English and French, each word has been taken to consist of one or more complete syllables except when sinalefa occurs or adjacent vowels at word boundaries form diphthongs. Other researchers in Spanish have allotted word final consonant durations to the following syllable when the latter begins with a vowel; "...por estas...buenos estudios..." /po res tas/ /bue no ses tu dios/ (Gili Gaya, 1940 : 219), "tener alas" /te ne ra las/ (Navarro Tomás, 1922 : 27), "en ancha capa" /e nan tʃa ka pa/ (Pointon, 1978 : 64). The other procedure has been adopted in this study for the following reasons:

1) Delattre investigated arresting and releasing formant transitions of intervocalic consonants in Spanish and found them to be about equal (Delattre, 1965 : 38). According to these results, it would therefore not make much difference which syllable the consonant duration is allotted to and would rather indicate that it should be split between the two.

2) Chela Flores, in a study of Caribbean Spanish, states that there are two distinct phonological systems in pre- and post-nuclear positions:

> "En el sistema postnuclear se encuentran fenómenos tales como la pérdida de la articulación supraglotal de las fricativas sordas y de las oclusivas, velarización de las nasales y de las oclusivas labiales, pérdida de oclusión de las líquidas y asimilación de las sonantes a la consonante siguiente"
> (In the postnuclear system, certain phenomena are found such as loss of supraglottal articulation of stops and voiceless fricatives, velarization of nasals and labial stops, loss of stricture for liquids and assimilation of sonants to the following consonant) (Chela Flores, 1982 : 28).

It is very likely that in Castilian Spanish, some of these phenomena are also present. There is certainly a very limited set of phonemes permitted in syllable final position and even more limited in word final position (cf. Chapter II).

3) In the present study, the data has shown syllable and word final consonants to be of less intensity than word or syllable initial consonants.

4) Vowels in Spanish are traditionally accepted as being open in closed syllables and close in open syllables (with some exceptions) but this feature is not altered in words where the final consonant is traditionally considered as detachable due to the following word initial segment being a vowel, e.g. "los hurras" [lɔsuras], not [losuras].

5) In the text examined, word final 'r' was realized as a tap never a trill like word initial 'r', e.g. "reunir a" [rreunir a], not [rreunirra]. (In word initial and word and syllable final position, the opposition /rr/ and /r/ is neutralized.)

Cases where word final consonants could have been detached and allotted to the following syllable were few; 15 syllables out of a total of 564. More research would have to be carried out in order to establish the most appropriate point of syllable division in these contexts, especially when both syllables concerned are unstressed. It is possible that in the case of a minimal pair such as "la 'sabes" and "las 'aves", the exact point of stress falls earlier in the first example than the second, therefore it is reasonable to include [s] in "las aves" in [las], however, a minimal unstressed pair such as "lo sabía", "los había" does not present any perceptual clue as to the allocation of [s]. When asked to disambiguate "la 'sabes" from "las 'aves", a native Spanish speaker did the following: lengthened the

vowel in "la", increased the intensity of [s] in "sabes" and reduced the intensity of [s] in "las". Obviously this [s] was felt to 'belong' to "las". (These examples are not in the text examined.)

When two adjacent vowels occur in separate words, there is a tendency for them to form one syllable either by combining into a diphthong, e.g. "que hace" [keaθe], or by the first vowel if it is /i/ or /u/ becoming a rapid glide, e.g. "como ella" [komweλa] or by dropping the first vowel altogether, e.g. "todo el mundo" [toδelmunδo], "hace el lagarto" [aθelaɣarˢto] (sinalefa) (Stress groups N°s 19, 51, 7, 19, 20). Pointon quotes Delattre and Navarro Tomás on this point:

> "the first vowel, if unstressed and not closer than the second tends to fall...(busc(a) una, cuart(a) oscuro); if unstressed and closer than the second, it tends to become a semi-vowel (ni una vez, su amigo)" (Delattre in Pointon, 1978 : 47)

in contradiction to Navarro Tomás

> "Las vocales que mas pierden son las de menor perceptibilidad. En igualdad de circumstancias respecto al acento la vocal mas abierta o perceptible es la que mejor conserva su cantidad y su timbre, constituyendo en el grupo silábico el elemento predominante"
> (Vowels which suffer greatest modification are the least perceptible. Stress conditions being equal, the most open or perceptible vowels are those which best retain their duration and quality, thereby forming the predominant element in the syllabic group)* (Navarro Tomás in Pointon, 1978 : 47).

Examples in the text examined agree with Delattre's claims: "fue interrumpido" [ˈfwinterrumˈpiδo], "todo hubiera" [toδuˈβjera], "callado hasta entonces" [kaˈλaδwastenˈtonθes] (Stress groups N°s 171, 172, 178, 179, 124, 125).

However, on occasions, sinalefa or some other modification did not occur where it might have been expected to in the text examined but the words were clearly divisible by some indication in the instrumental tracing such as the typical dip in the intensity tracing between syllables. The occurrence of sinalefa seems to depend on a

*Author's translation

number of factors: the rate of speech, intonation, the emphasis which the speaker places on any particular word or syllable and the frequency of the semantic group in the language; for example, almost every Spanish speaker would say "todo el mundo" [toδelmundo].

2.3.3.2 Identification of Stressed Syllables

The same method was used as for English and French. There was very little disagreement between the native speakers (who were from various parts of the Spanish-speaking world) as to stress placement. Certain function words which would be stressed when said in isolation were considered as stressless in the recording.

2.3.3.3 Syllable Division

The same basic procedure was followed as for English and French. Many Spanish speakers, particularly South Americans, neutralize /e/ and /i/ when they occur as unstressed vowels preceding a stressed vowel and the realization is [j], e.g. "leon" [ljon]. In this case, the word is considered to be monosyllabic. The informant however, preserved the [e] - [le'on] and the word in each case was clearly composed of two syllables. In some occurrences of two adjacent unstressed syllables, division was impossible and half the duration of both was given to each one. These figures were not used in the tests which required precision of syllable durations. Where a voiced approximant occurred intervocalically it was often impossible to allot any value to the segment and these syllables were divided at the point of least intensity, according to the instrumental tracings.

2.3.3.4 Segment Division and Syllable Nuclei

As for English and Spanish, where it was not possible to obtain segment durations from the tracings, the data was omitted from the test dealing with syllable nuclei. Any delay in voice onset following voiceless stops was allotted to the vowel duration. This was not

frequent and in all cases, very short. The duration of the short [ə]-type vowel which is produced when [r] has a fricative or stop adjacent to it, e.g. "ser sakrificados primero" [ser sak ᵊrifikaðos pᵊrimero], was allotted to [r]. The duration of this vowel is very short, usually about 30 msecs and not exceeding 40 msecs. The vowels were considered as syllable nuclei with the above exception. Approximants [j] and [w] were included in syllable nuclei when preceded by a releasing consonant as they were indistinguishable from the following vowel. In this position they are considered as vowel allophones anyway (cf. Chapter II). [l] occurred only twice in clusters: "indispensables" [inðispen'saβles] and "explosión" [esplo'sjon]. In the latter, it was distinguishable from the following vowel but not in the former, which was utterance final anyway and therefore not used. The nasals on the whole exhibited typical speech wave-form patterns and were thus segmentable.

3. Results

3.1 The Syllable

3.1.1 Syllable Duration

3.1.1. a) Variation in Syllable Duration

All syllables in the three texts were used for this test. Utterance final syllables were included because when stressed, they will presumably be of greater duration in a stress-timed language than a syllable-timed, as they would correspond to mono-syllabic pre-pausal stress groups in English and therefore make the variation more apparent. The total number of syllables used was English : 438, French : 436, and Spanish : 541. (For complete segmentation of the three texts, see Appendix 5).

The results are presented in Figures 21, 22, 23 and 24, Figure 21 showing the percentage of the total number of syllables against

syllable duration, Figure 22 the percentage of the total number of stressed syllables against syllable duration, Figure 23 the percentage of the total number of unstressed syllables against syllable duration and Figure 24 the total number of syllables, stressed syllables and unstressed syllables against syllable duration for each language. The total range of syllable duration was 43-539 ms for English, 56-484 for French and 43-352 ms for Spanish, indicating the greatest total variation for English, and the smallest for Spanish. As there was a different number of syllables for each language and of widely differing durations, standard deviations were calculated and F tests for variance were applied. The results are presented in Table 25.

Considering all syllables in Table 25 and Figure 21, it is clear that there is much greater variation in distribution of syllable durations in English than in Spanish. The total range is greater in English and the standard deviation for English is 97.32, whereas that for Spanish is 54.76 ms. The figures for French are closer to those for English. The histograms for English and French (Figure 21) are remarkably similar in form, whereas that for Spanish presents a much more concentrated distribution. F tests for variance showed that for all syllables, the variation in English was significantly greater than in French, $F = 1.53$, $p < .01$, and Spanish $F = 3.6$, $p < .01$, and variation in French significantly greater than in Spanish, $F = 2.07$, $p < .01$. Considering therefore the total number of syllables in the samples examined, there is quite a wide range of syllable duration in each language but Spanish exhibits the smallest range and the least variation. French emerges as being closer to English than to Spanish.

Similar results are obtained considering the stressed syllables only. According to the histograms for stressed syllables (Figure 22 and the

Figure 21

English, French and Spanish : Noah's Ark

Histograms of syllable duration as percentage of total number of syllables

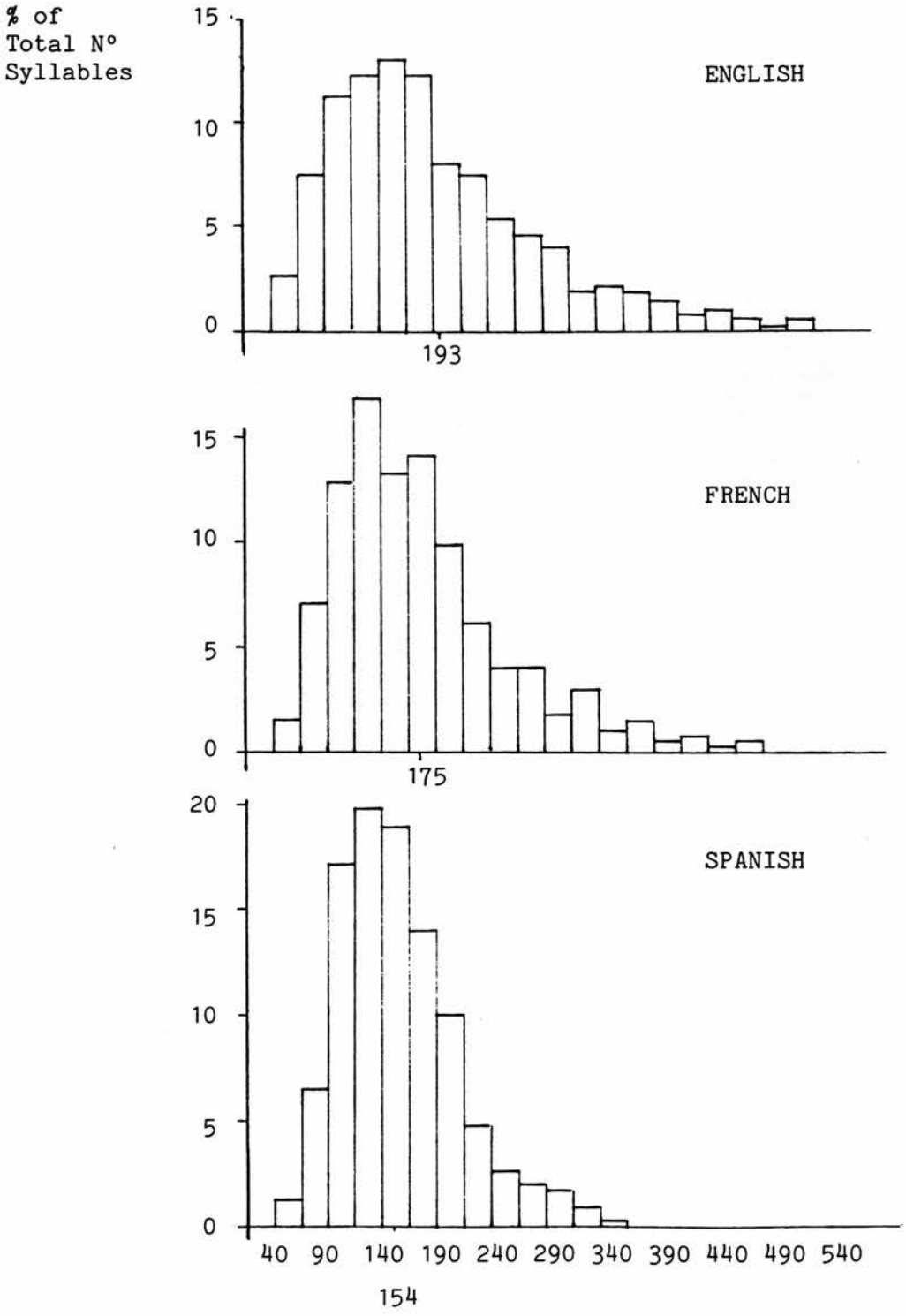


Figure 22

English, French and Spanish : Noah's Ark

Histograms of stressed syllable duration as percentage of total number of stressed syllables

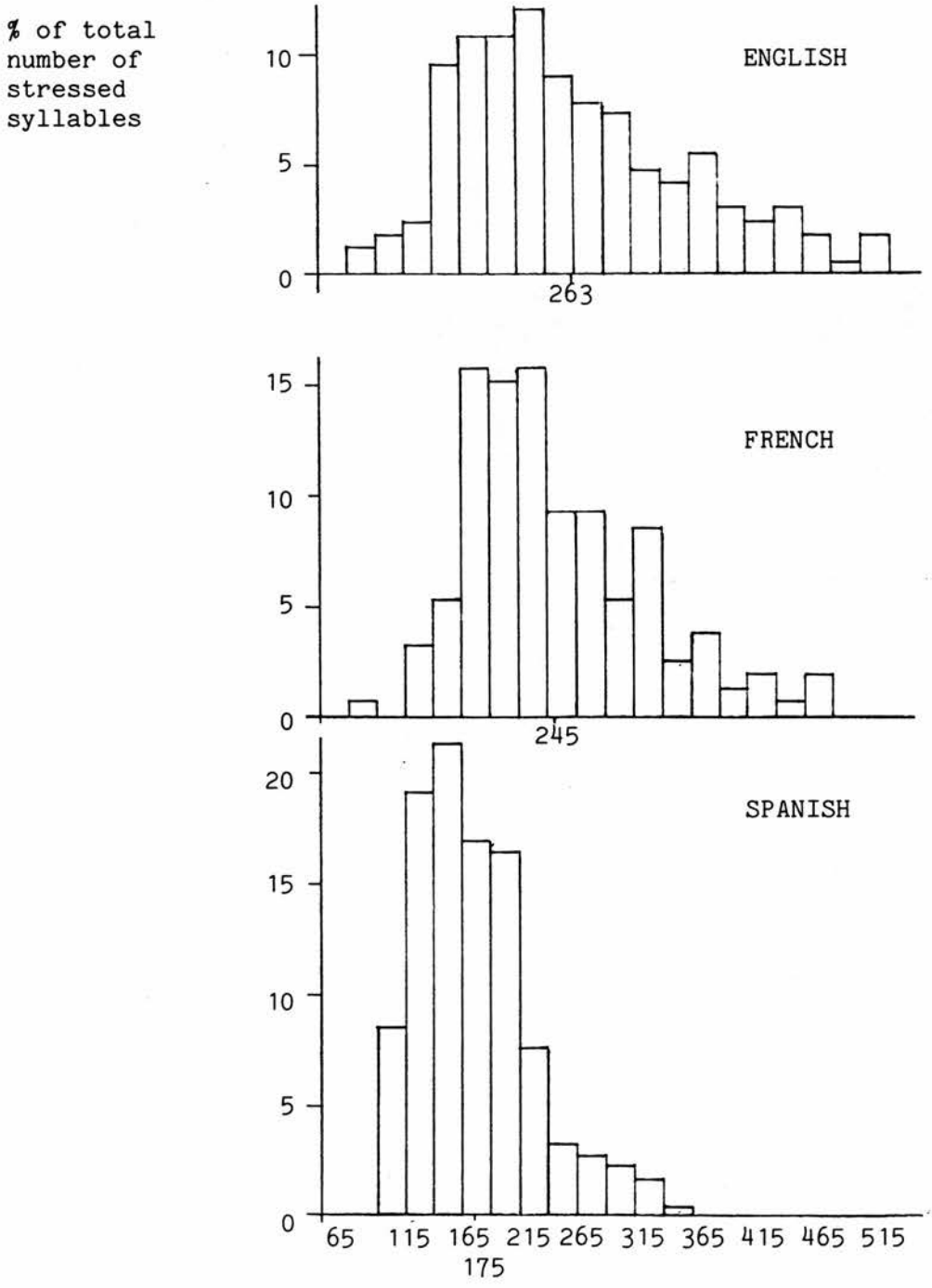


Figure 23

English, French and Spanish : Noah's Ark

Histograms of unstressed syllable duration as percentage of total number of unstressed syllables

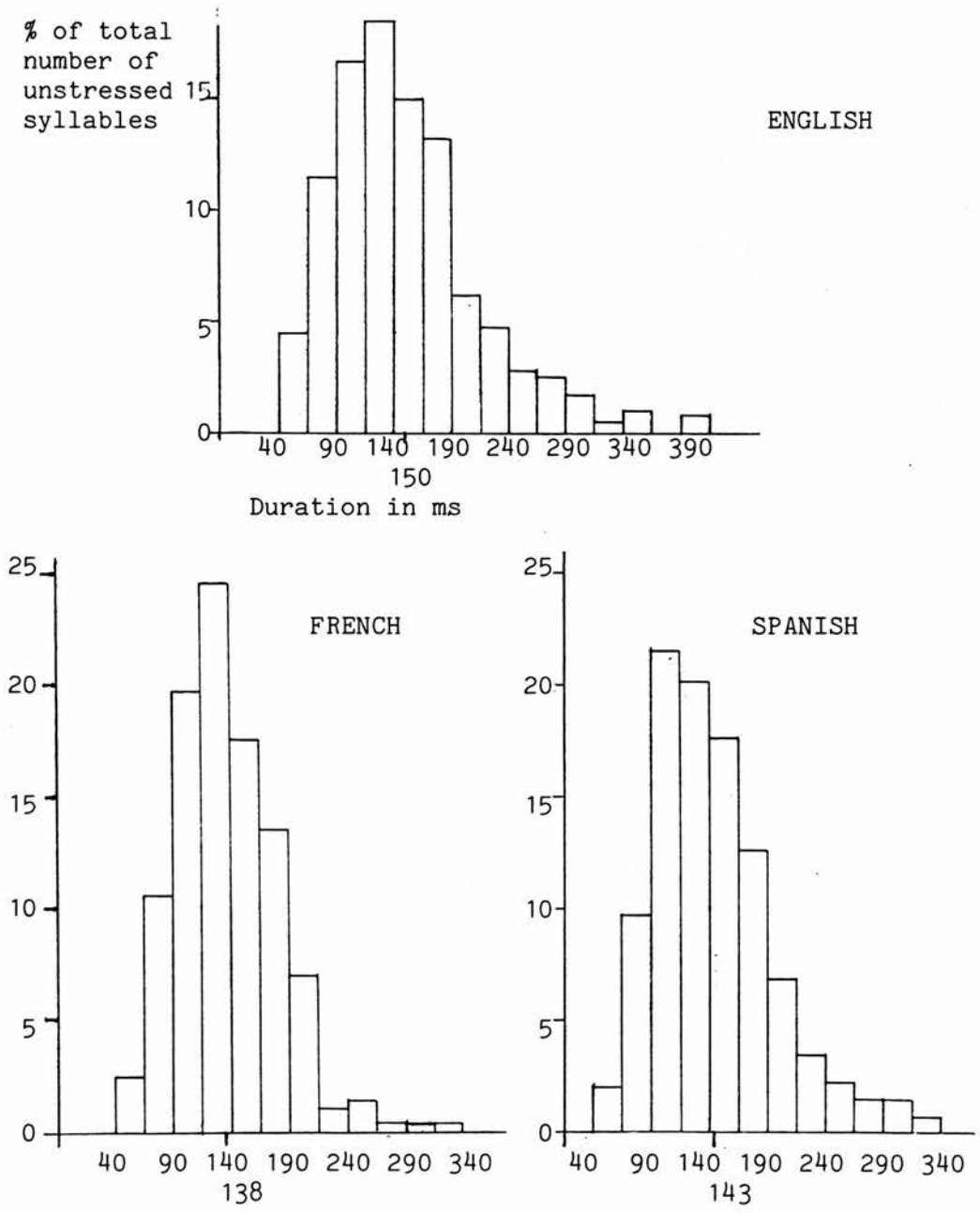


Figure 24

English, French and Spanish : Noah's Ark

Graphs of syllable duration according to number of syllables (all syllables)

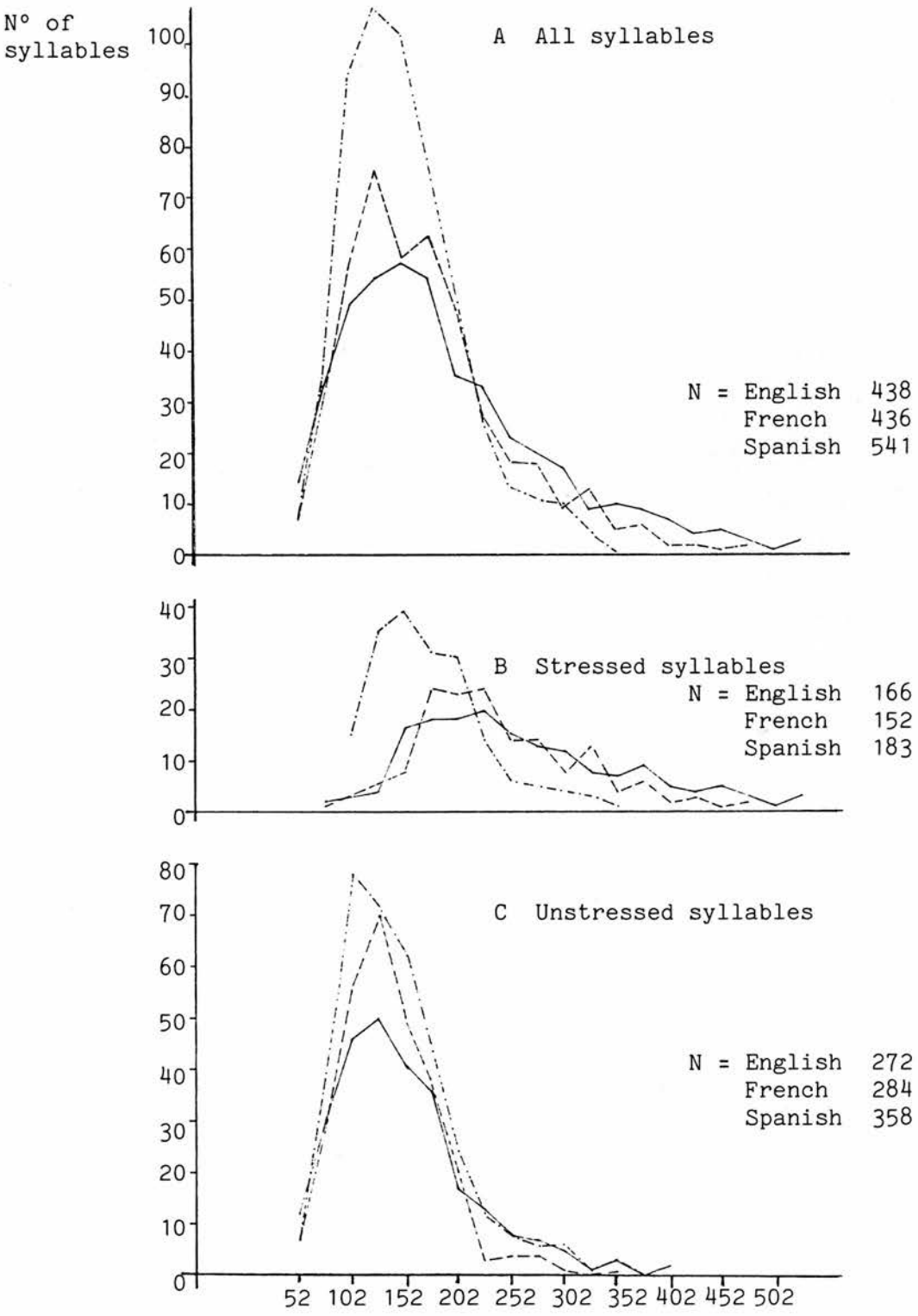


TABLE 25

English, French and Spanish : Noah's Ark

Syllable Duration Compared
All syllables in milliseconds

		English	French	Spanish
All Syllables	N	438	436	541
	R	43 - 539	56 - 484	43 - 352
	AD	193	175	154
	SD	97.32	78.8	54.76
All stressed syllables	N	166	152	183
	R	66 - 539	84 - 484	90 - 352
	AD	263	245	175
	SD	100.25	75.4	52.09
All unstressed syllables	N	272	284	358
	R	43 - 395	56 - 359	43 - 332
	AD	150	138	143
	SD	65.28	46.8	52.3

N = number of syllables
R = range in milliseconds
AD = average duration
SD = standard deviation.

corresponding part of Table 25), French would again appear to lie somewhere between the other two languages and the range of stressed syllable durations, 84-484 ms is closer to the range for English, 66-539 ms than to Spanish, 90-352 ms. The differences were still significant however, and in the same order, English > French $F = 1.77$, $p < .01$, English > Spanish, $F = 3.7$, $p < .01$, and French > Spanish, $F = 2.06$, $p < .01$.

Considering the unstressed syllables separately (Figure 23 and Table 25), average durations are very similar, English 150 ms, French 138 ms and Spanish 143 ms. The standard deviation however is greater for Spanish than for French. F tests showed that variation in English is still significantly greater than French, $F = 1.95$, $p < .01$ and Spanish $F = 1.56$, $p < .01$, and although there was greater variation in Spanish than French, it was not significant. Spanish emerges as being closer to syllable timing than French and English when all syllables are considered. French unstressed syllables may not vary much in their durations (when compared to Spanish) but stressed syllables and all syllables certainly do. English exhibits the greatest variation of syllable duration in all three tests.

Figure 24 shows the distribution of the actual number of syllables for all languages. It is to be expected that Spanish should have a higher peak than the other two languages in A, B & C because more syllables were included in the sample. The curves behave as one would expect them to do so, the curve for English being flatter in each case and showing a more varied distribution. French is the only language exhibiting two peaks in A which correspond to the peaks for stressed and unstressed syllables in B and C, the peaks for unstressed syllables in A and C having almost the same number, A - 75 and C - 70,

whereas those for stressed syllables differ considerably, A - 62 and B - 24, from which it can be assumed that the unstressed syllable durations overlap into those of the stressed rather than vice-versa. This graph, however, is not as reliable as the other three, but is included to give a general contrastable picture.

The results of this first analysis support the hypothesis that Spanish is more inclined to syllable-timing than stress-timing and bring out important differences between French and Spanish. French obviously makes use of duration as a stress correlate to a much greater extent than Spanish. Three factors indicate this: a) the total syllable duration variation of French compared to Spanish, ($F = 2.07$, $p < .01$); b) the average durations of stressed and unstressed syllables, French unstressed = 138 msecs, stressed = 245 msecs, an increase of 78% compared to Spanish unstressed 143, stressed 175 msecs, an increase of only 22%, barely above the JND's (cf. Chapter IV); and c) the relatively small variation within the unstressed syllables in French (Standard deviation = 46.8 ms). Even in English, the average durations do not increase by as much; unstressed = 150 msecs, stressed = 263 msecs, an increase of 75%, and in English, the variation within both groups of syllables is significantly greater than French so there will be much more overlapping. The increase in duration on French stressed syllables could be attributable to different factors. According to Wenk and Wioland, stressed syllables in French have no intensity increment and they connect this to their position within the stress group on the rhythm curve (Section 2.3.3.1). There is also a delayed pitch change, but duration is the most consistent correlate whereas stressed syllables in English are characterized by extra lengthening, intensity increment and pitch jump (Wenk and Wioland, 1982 : 204). The majority of utterance final syllables in French were

stressed in the data, which adds pre-pausal lengthening. In Spanish, there were few utterance final stressed syllables, so pre-pausal lengthening would reduce the gap between average durations of stressed and unstressed syllables.

Another factor might involve syllable-timing within groups of unstressed syllables. If there is an expected regularity of syllable duration, anything different from that will be perceived as prominent.

As the stressed syllable is not characterized by an intensity increment (because the previous unstressed syllables in the group have equal or greater intensity), utterance final syllables will require a double increase in duration so to speak, in order for them to achieve the status of stressed, as the native listener will allow for a certain amount of pre-pausal lengthening.

Spanish also has phonological word accent so phonetic empathy can be relied on to a certain extent for perception of stress. The accented syllables are almost always stressed (exceptions in 3.1.3) and emphasis, when it occurs, is simultaneous with stress. In Chapter IV it was found that in Spanish all other things being equal, when the first syllable of disyllabic words is stressed, it is approximately the same length as the second, but when the second is stressed, it is longer than the first. This also fits in with the theory that when the stressed syllable is last in the group, extra duration is consistently a correlate.

Considering only syllables of utterance internal stress groups, similar results are obtained. These are presented in Figures 25 to 28 and Table 26. Comparing Figure 21 and 25, the general shape for each language is similar in both but in Figure 25 there is slightly less

Figure 25

English, French and Spanish : Noah's Ark

Histograms of syllable duration as percentage of all syllables of utterance-internal stress groups.

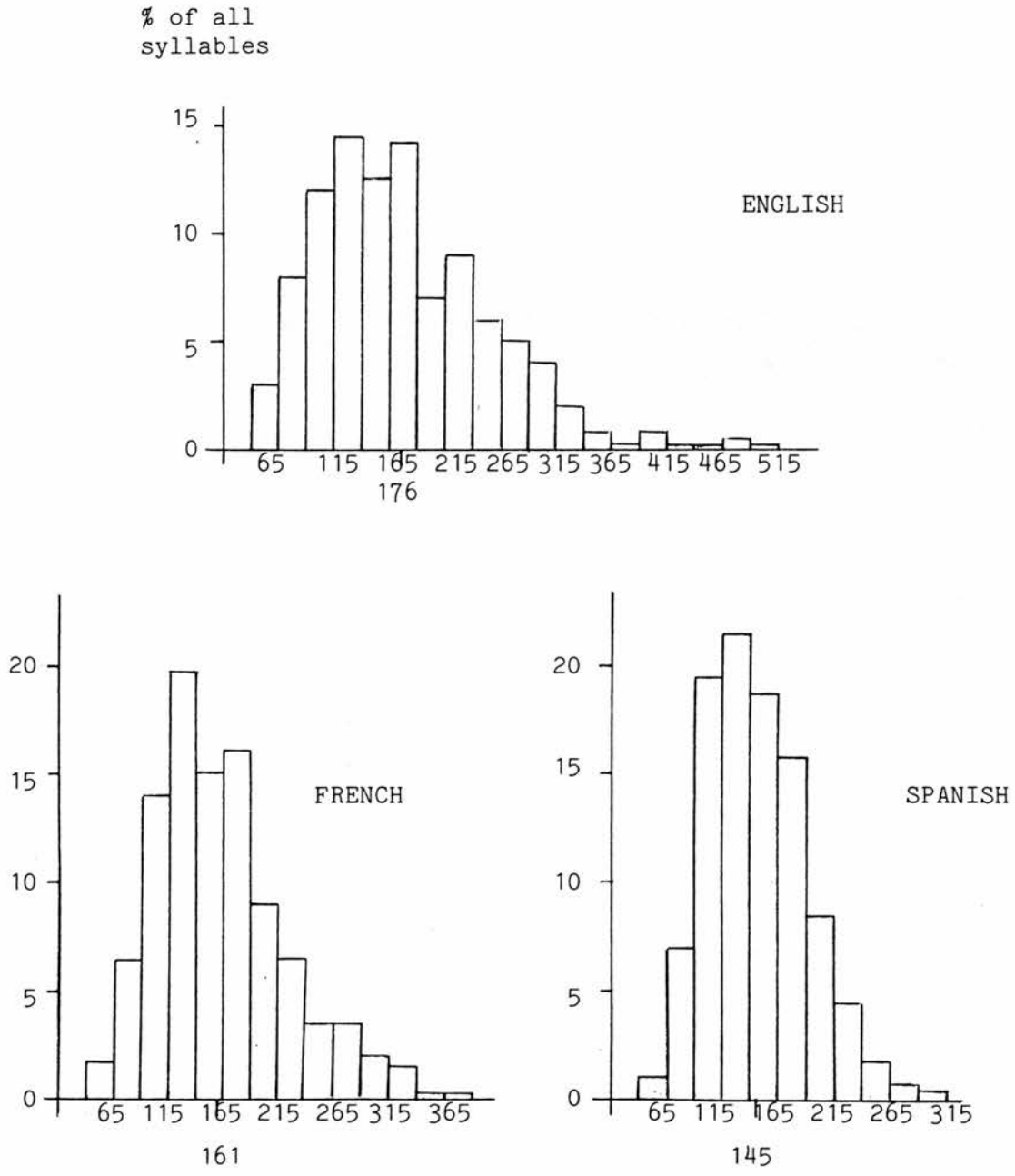
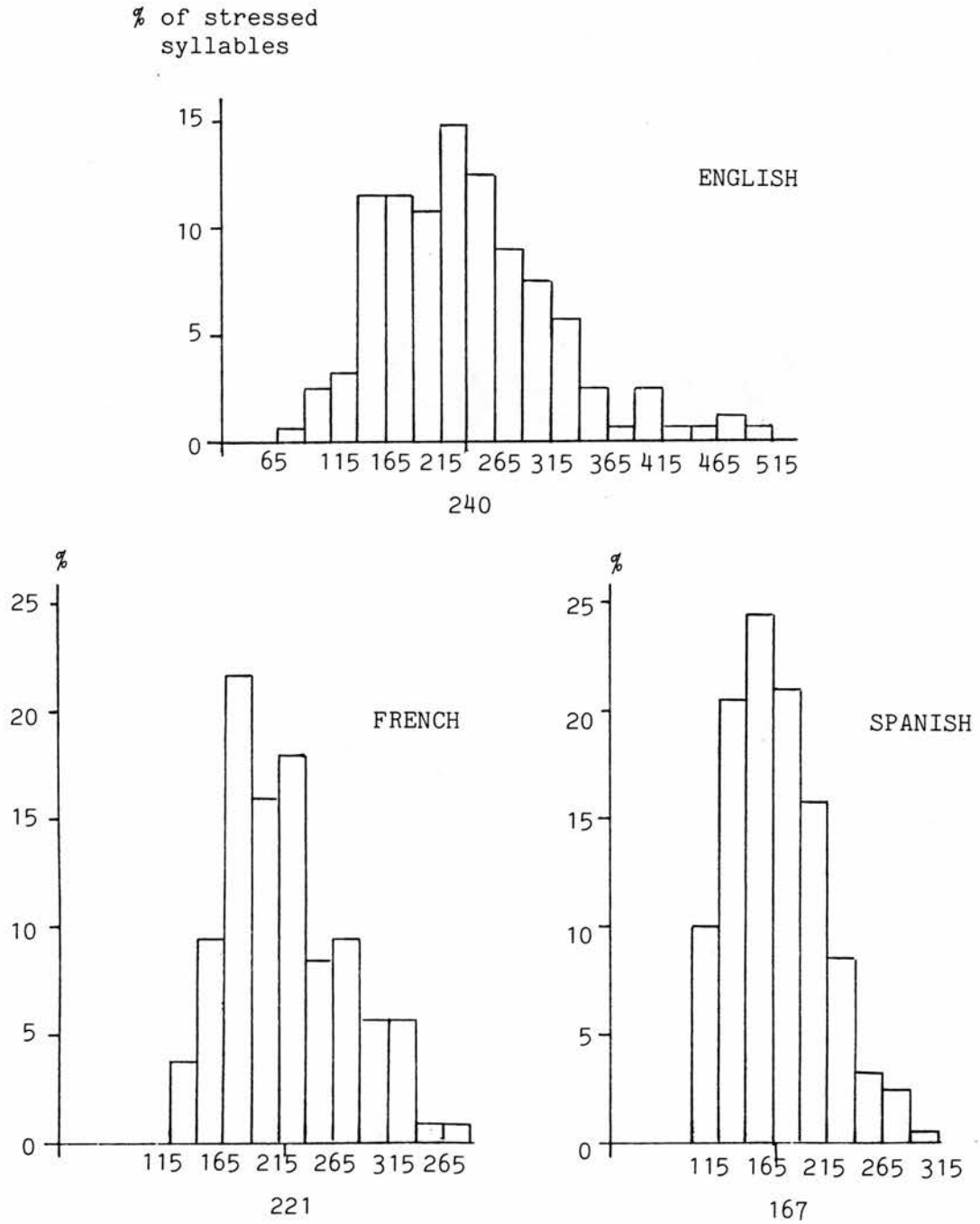


Figure 26

English, French and Spanish : Noah's Ark

Histograms of stressed syllable duration as percentage of all stressed syllables of utterance-internal stress groups.

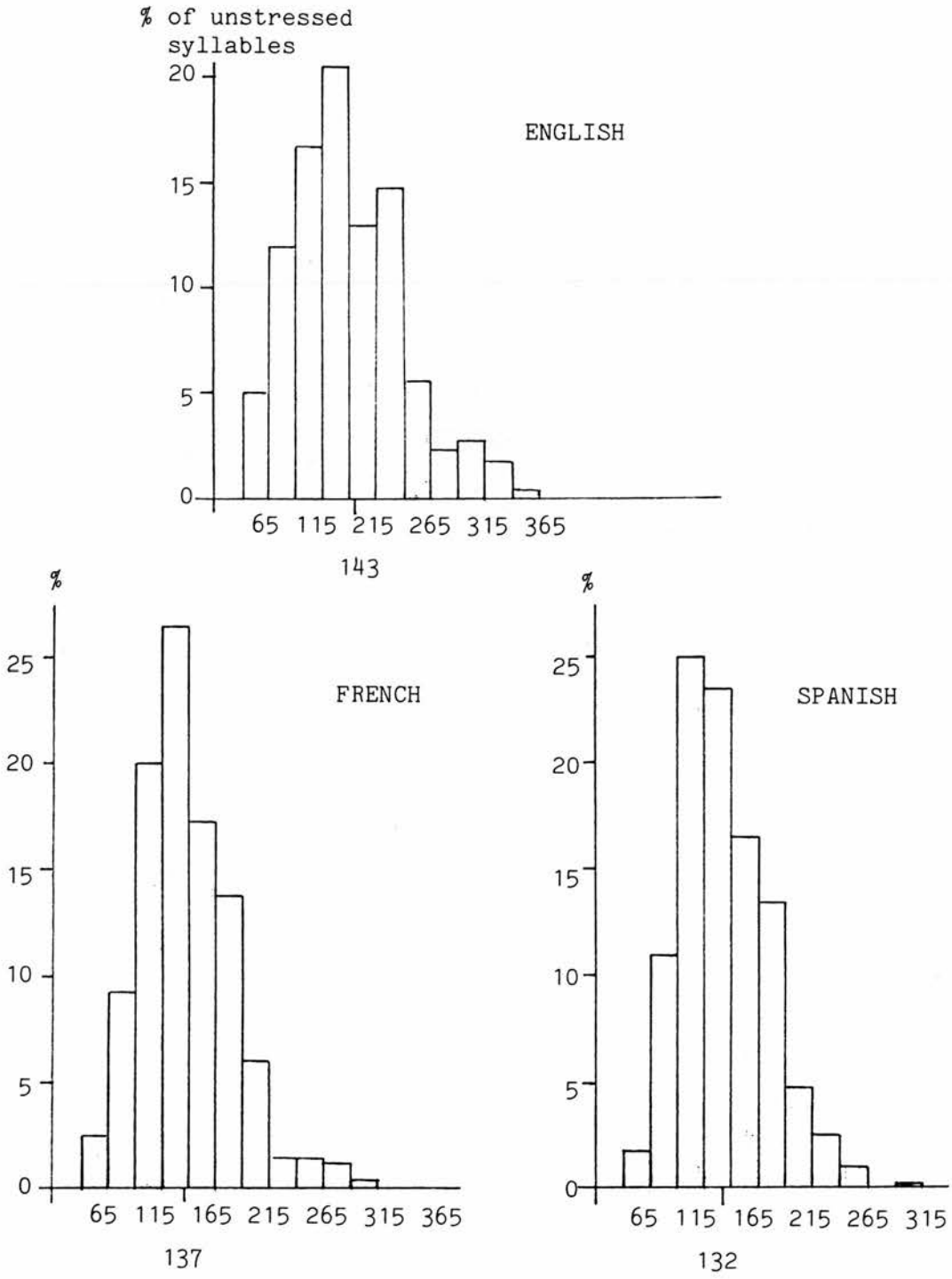


Syllable duration in ms showing averages

Figure 27

English, French and Spanish : Noah's Ark

Histograms of unstressed syllable duration as percentage of all unstressed syllables of utterance-internal stress groups



Syllable durations in ms showing averages

Figure 28

English, French and Spanish : Noah's Ark

Graphs of syllable duration according to number of syllables of utterance-internal stress groups.

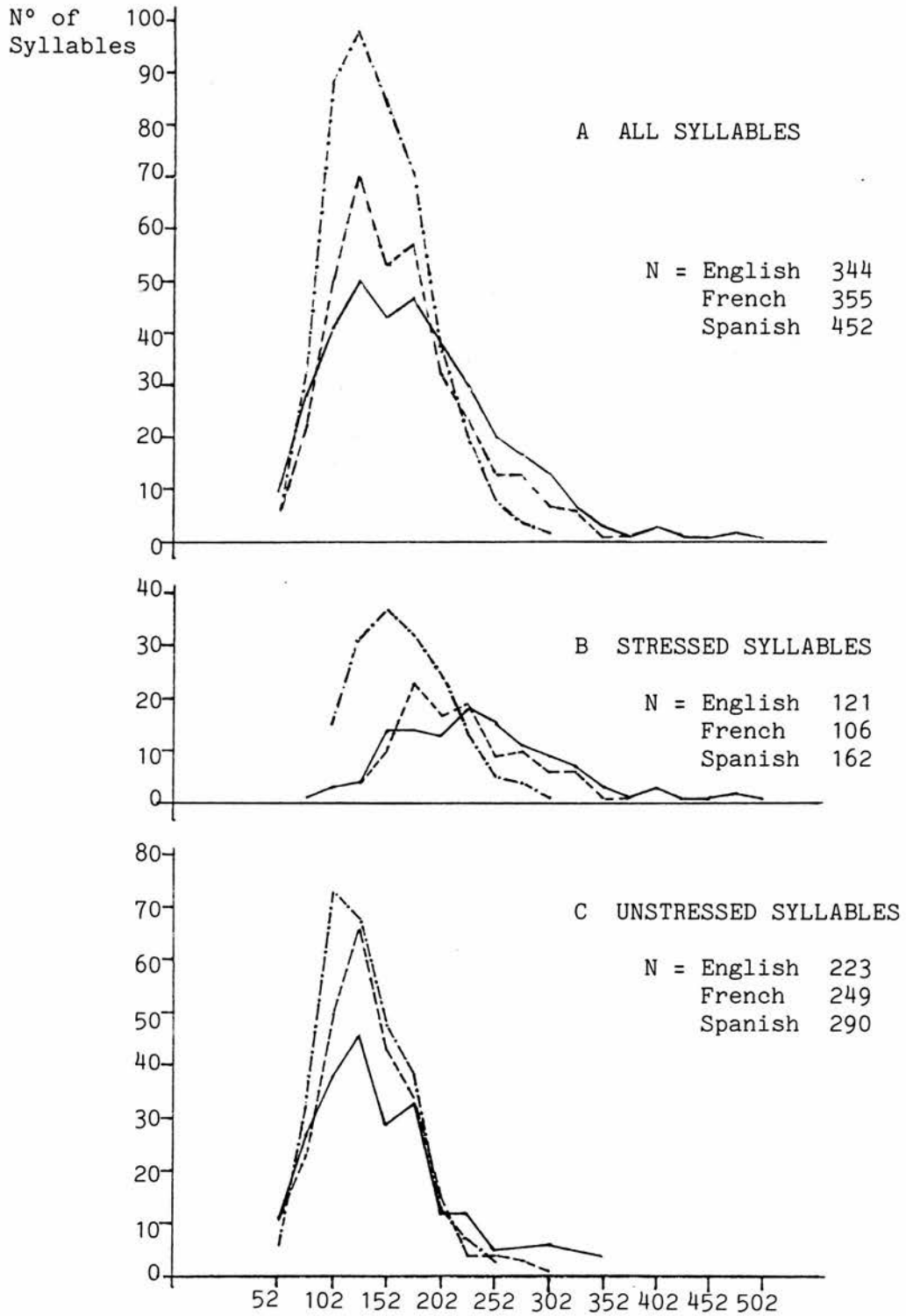


TABLE 26

English, French and Spanish : Noah's Ark

Syllable duration compared -
syllables contained in utterance-internal stress groups

		English	French	Spanish
All Syllables	N	344	355	452
	R	43 - 486	56 - 379	43 - 311
	AD	176	161	145
	SD	78.77	60	44.5
Stressed Syllables	N	121	106	162
	R	86 - 486	122 - 379	90 - 311
	AD	240	221	168
	SD	82.39	55.19	43.27
Unstressed Syllables	N	223	249	290
	R	43 - 298	56 - 295	43 - 290
	AD	143	137	132
	SD	56.8	44.48	41.63

N = Number of syllables
R = Range in milliseconds
AD = Average Duration
SD = Standard Deviation.

positive skew. The average durations for all syllables show a difference of 17 msecs in English (193 - all syllables, 176 - internal), 14 msecs in French (175-161) and only 4 msecs in Spanish (154-150). This would indicate more pre-pausal lengthening in English and French than Spanish. However, one must bear in mind that the majority of Spanish pre-pausal syllables are unstressed. An F test for variance was applied to all internal syllables with the following results: English -greater variation than French, significant F = 1.72, $p < .01$; French - greater variation than Spanish, significant, F = 1.82, $p < .01$; English - greater variation than Spanish, significant, F = 3.13, $p < .01$. The range of syllable durations also follows the same pattern (Table 26), the widest range in English, the narrowest in Spanish. Comparing Figures 22 and 26, stressed syllables only, again there are the same general differences, less positive skew in Figure 26, a higher concentration of syllable durations just below the mean and lower average durations. The difference between average durations of stressed syllables is slightly greater than for all syllables, English 23 msecs (263-240), French 24 msecs (245-221) and Spanish 8 msecs (175-167). The fact that most pre-pausal syllables in French are stressed has increased the difference, but this still indicates more pre-pausal lengthening in English and French than Spanish. The range of durations for stressed syllables of utterance internal groups was again widest in English (86-486 ms) and narrowest in Spanish (90-311 ms) (Table 26). An F test for variance was applied to this data and the following results were obtained:

English, greater variation than French; significant, $F=2.23$, $p < .01$.
French, greater variation than Spanish; significant, $F=1.63$, $p < .01$.
English, greater variation than Spanish; significant, $F=3.63$, $p < .01$.

Comparing Figures 23 and 27, again there is a more concentrated distribution around the mean in Figure 27 than in Figure 23, although very little change in the French histogram. There is little difference between average durations of all unstressed syllables and unstressed syllables of internal stress groups, only 7 msecs in English (150-143), 11 msecs in Spanish (143-132) and 1 msec in French which is insignificant. The vast majority of French utterance final syllables were stressed and the majority of Spanish, unstressed. It must be remembered that these are not differences in average durations between pre-pausals and internal syllables, but between all syllables and internal syllables. The difference between pre-pausal and internal syllables is of course much larger and is referred to later. The range of durations for unstressed syllables of internal groups is almost the same for each language, English 43-298 msecs, French 56-295 msecs and Spanish 43-290 msecs (Table 26). Applying the F test for variance, the results were slightly different:

English, greater variation than French; significant, $F=1.63$, $p < .01$.
English, greater variation than Spanish;significant, $F=1.86$, $p < .01$.
French, slightly greater variation than Spanish; not significant,

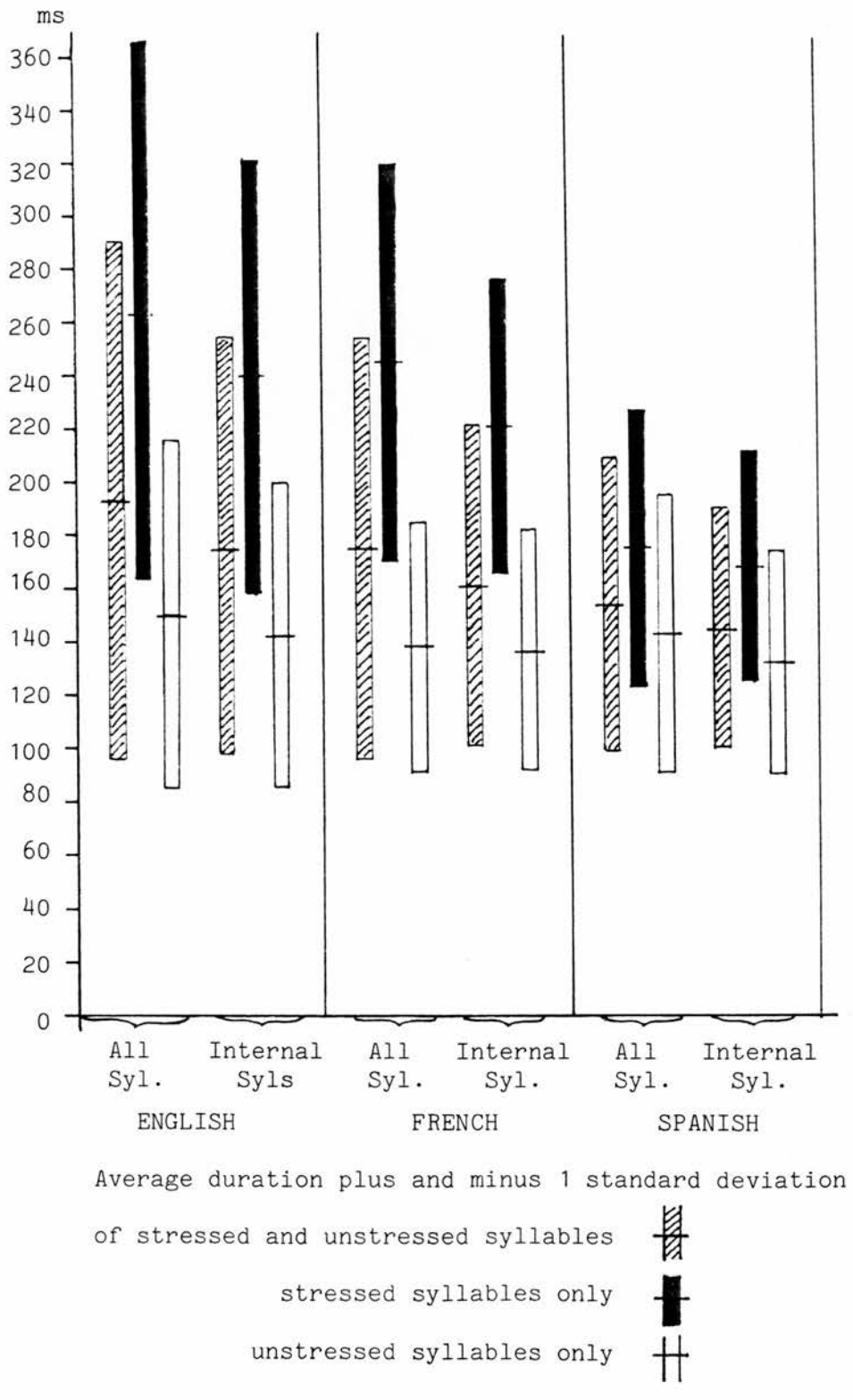
$F = 1.14$, $p > .05$.

Figure 28 has been included, again to give a general contrastable picture and the lines behave in almost exactly the same way as in Figure 24, Spanish having the highest peaks, corresponding to numbers of syllables of similar durations, in each case, and English the flattest curves, indicating wider distribution. Figure 29 shows the average durations of each syllable type discussed here plus and minus one standard deviation for each language. The difference in range is striking, the range in Spanish being very narrow compared to the other two languages, although the inferior limit is almost the same for all syllables and the unstressed syllables of each language.

Figure 29

English, French and Spanish : Noah's Ark

Average durations and standard deviations of all syllables compared to those of utterance-internal stress groups.



According to these results, Spanish is the only language showing a tendency towards syllable-timing due to the majority of syllables lying within a narrow range and the small difference between all syllables and those of internal stress groups and between stressed and unstressed compared to the other two languages examined. Unstressed syllables in French behave in a similar way to all syllables in Spanish.

The average durations of pre-pausal syllables and those of internal stress groups were also compared and the results presented in Table 27. In English, the majority of pre-pausal syllables were stressed; 28 out of a total of 40. In French almost all were stressed; 37 out of a total of 40. But in Spanish, the majority were unstressed; 38 out of a total of 47. This explains the apparent anomaly in the ratios. All syllables include stressed and unstressed, but in unequal proportions between internal and pre-pausal. The average difference therefore between internal and pre-pausal syllables is greater in French and English when all syllables are considered together than when stressed and unstressed are considered separately and of course smaller in Spanish, where the majority of pre-pausal syllables are unstressed. In general, Spanish has the least pre-pausal lengthening (about 60% average internal syllable duration added), English the most (about 100% duration added) and French again lies somewhere in between (approximately 80%). The position is reversed between French and Spanish when stressed and unstressed syllables are considered separately. The ratio between Spanish stressed internal and pre-pausal syllables is greater than in English although the increase in actual milliseconds is less (see also Chapter IV for a discussion of pre-pausal lengthening in Spanish). Pre-pausal lengthening as a property of the stress group will be discussed later (Section 3.2.3).

TABLE 27

English, French and Spanish : Noah's Ark

Average durations in ms and ratios of syllables of utterance-internal stress groups and pre-pausal syllables

	Internal			Pre-pausal		
	All	Stressed	Un-stressed	All	stressed	Un-stressed
English	176	240	143	350	378	283
French	161	221	137	285	294	(174)
Spanish	145	168	132	231	291	217

( ) = only 3 examples

Ratios			Difference in ms
English :	All internal to all pre-pausal	1 : 1.99	(174)
	Stressed internal to stressed pre-pausal	1 : 1.58	(138)
	Unstressed internal to unstressed pre-pausal	1 : 1.98	(140)
French :	All internal to all pre-pausal	1 : 1.77	(124)
	Stressed internal to stressed pre-pausal	1 : 1.33	(73)
	(Unstressed internal to unstressed pre-pausal)	1 : 1.27	(37)
Spanish :	All internal to all pre-pausal	1 : 1.59	(86)
	Stressed internal to stressed pre-pausal	1 : 1.73	(123)
	Unstressed internal to unstressed pre-pausal	1 : 1.64	(85)

3.1.1 b) Variation in syllable duration according to stress group type.

In a stress-timed language, the components of the stress group are manipulated in order to preserve at least the impression of isochrony. One would not expect the same adjustment to occur in a syllable-timed language. Syllable durations were compared according to the type of stress group in which they were contained. As mentioned in sections 2.3.1.1 and 2.3.2.1 of this chapter, French and Spanish were analyzed by two different methods. The results are presented in Table 28 and Figure 30. The second method of division into stress groups for Spanish will be called word-group-timed. For the trailer-timed analysis of French and the word-group-timed analysis of Spanish, post-pausal stress groups were also used. Although they were slightly shorter on average (approximately 10 ms for each type) in French than the internal groups and slightly longer in Spanish for 2-syllable groups (other types were the same), these differences were not significant and they were therefore included to increase the sample. A few post-pausal groups with initial voiceless stops had to be omitted as the stop duration was impossible to measure. Both analyses of French and Spanish were tested to find out which exhibited more uniformity of average durations within the units and/or more consistent tendencies.

There was very little difference between the two for French - the range of average durations from 1 to 5-syllable stress groups is slightly smaller in the trailer-timed analyses (Table 28), but an F test for variance was applied and the difference was not significant ($F = 1.02$). In fact, the variation was almost the same, leader-timed standard deviation = 169 ms, trailer-timed standard deviation, 170.72. One and two-syllable groups are slightly longer in the trailer-timed

TABLE 28

English, French and Spanish : Noah's Ark
Average durations of stressed and unstressed syllables and stress groups according to stress group type in ms.
2 analyses for French and Spanish.

	Number of Syllables in Stress Group					
English (L-T)	1	2	3	4	5	6
Av dur S syl	312	252	225	222	165	
Av dur US syl		142	146	135	142	
Av dur S group	312	394	517	628	732	
Ratios to 1-syl gp	1	1:1-26	1:1.7	1:2.0	1:2.35	
Ratios between stress groups		1-2 1:1.26	2-3 1:1.3	3-4 1:1.2	4-5 1:1.17	
French (L-T)						
Av dur S syl	246	214	225	208	224	266
Av dur US syl		146	138	135	143	118
Av dur S group	246	360	501	612	796	854
Ratios to 1-syl gp	1	1:1.46	1:2.04	1:2.49	1:3.24	1:3.47
Ratios between stress groups		1-2 1:1.46	2-3 1:1.39	3-4 1:1.22	4-5 1:1.3	5-6 1:1.07
French (T-T)						
Av dur S syl	257	243	228	212	205	(205)
Av dur US syl		142	138	137	145	124
Av dur S group	257	383	501	618	782	(827)
Ratios to 1-syl gp	1	1:1.49	1:1.95	1:2.4	1:3.04	(1:3.22)
Ratios between stress groups		1-2 1:1.49	2-3 1:1.31	3-4 1:1.23	4-5 1:1.27	5-6 (1:1.06)
Spanish (L-T)						
Av dur S syl	165	155	167	167	180	179
Av dur US syl		146	139	128	123	115
Av dur S group	165	301	439	551	673	755
Ratios to 1-syl gp	1	1:1.83	1:2.66	1:3.34	1:4.08	1:4.58
Ratios between stress groups		1-2 1:1.83	2-3 1:1.43	3-4 1:1.26	4-5 1:1.22	5-6 1:1.12
Spanish (W-G-T)						
Av dur S syl	190	171	158	158	158.5	
Av dur US syl		140	140	142	132	
Av dur S group	190	313	441	585	663	(870)
Ratios to 1-syl gp	1	1:1.64	1:2.32	1:3.07	1:3.48	(1:4.57)
Ratios between stress groups		1-2 1:1.65	2-3 1:1.41	3-4 1:1.33	4-5 1:1.13	

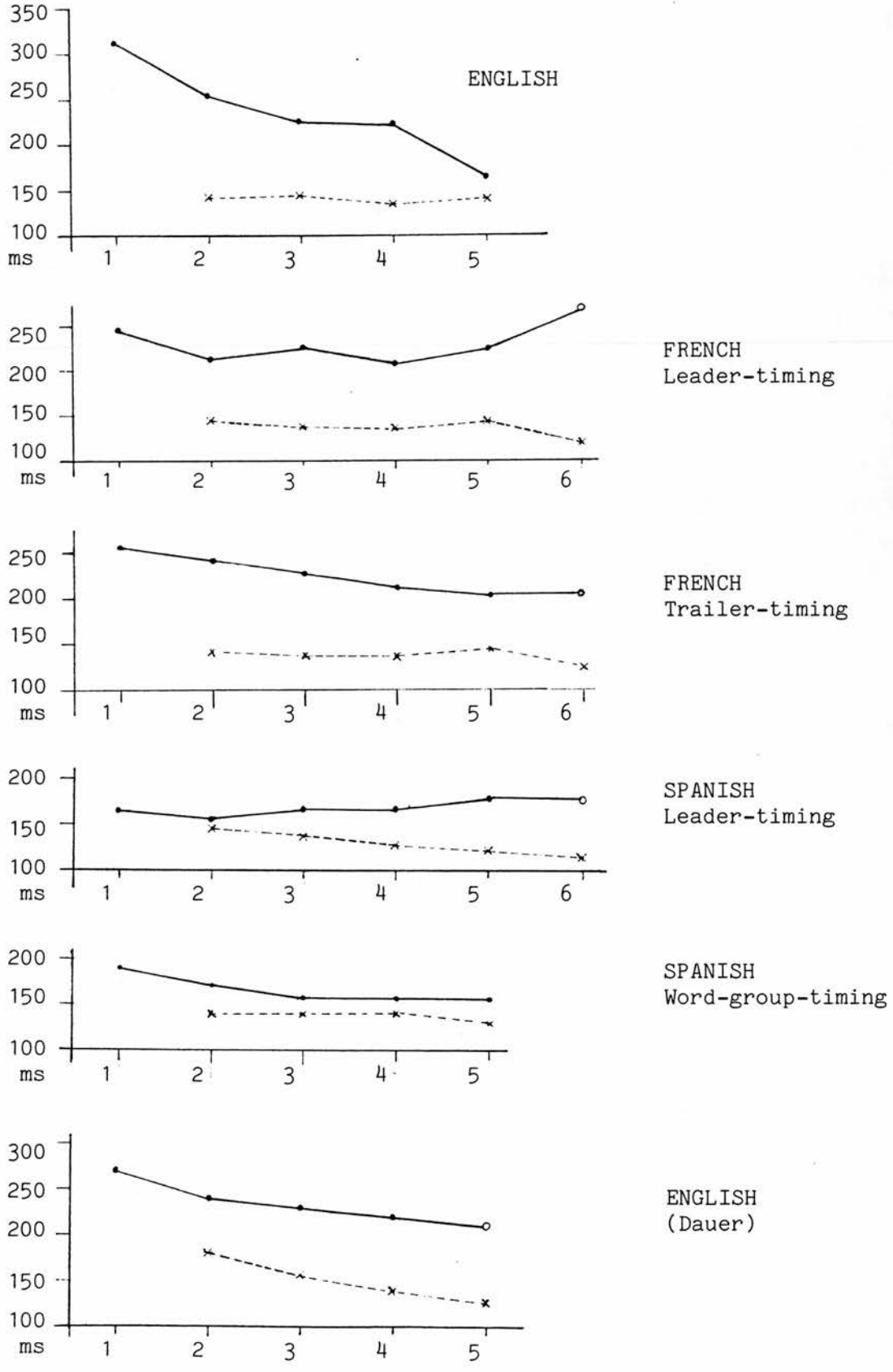
Notes:
L-T = leader-timing; T-T = trailer-timing; W-G-T = word-group-timing
Av = average; dur = duration; S = stressed; syl = syllable
US = unstressed; gp = group.

analysis but again these differences are not significant. However that may be, a comparison of the two graphs for French (Figure 30) does show a different trend for the stressed syllables. There is a more consistent decrease in their average durations as the number of syllables per stress group increases in the trailer-timed analysis than in the leader-timed analysis. The unstressed syllables behave in almost the same way in both graphs. The fact there there is no significant difference between the two methods of analysis indicates that syllables in French do not alter their duration according to the number of syllables per stress group. According to this, either method of analysis is valid, and it also supports the theory that French has a syllable-based rhythm, that is that the duration of the syllable is independent and consistent, no matter how long or short the interstress interval is. If this were not the case, there would be a difference in the variation of all stress groups and surely a greater difference than 11 msecs in average durations of syllables in monosyllabic stress groups. This will be discussed at greater length in Section 3.2.1. However, as French has a preference to stress utterance and word final syllables and the graph for trailer-timing does show a slight decrease in average durations of stressed syllables, the more syllables per group and considering also Wenk and Wioland's conclusions concerning explicitness of articulation in French unstressed syllables (Section 2.3.3.1), it is thought that the trailer-timed analysis is preferable for French.

In Spanish the differences are more apparent. The range of average durations of stress groups is smaller in the word-group-timed analysis (190-663 ms) than in the leader-timed (165-673). An F test was applied to all stress groups and the result was just significant: variation in the leader-timed analysis greater than in the word-group-

Figure 30

English, French and Spanish : Noah's Ark
Graphs of Average durations of stressed and unstressed syllables according to stress group type. 2 analyses for French and Spanish.



timed, $F = 1.39$, $p < .05$. A T test was also applied to monosyllabic stress groups but the difference between leader-timing and word-group-timing was not significant (cf. Chapter VI for further statistical tests on Spanish). The two graphs of Spanish (Figure 30) do show different trends for both stressed and unstressed syllables. The preferred duration of the stressed syllable would seem to be approximately 158 ms, average duration of stressed syllables of 3, 4 and 5 syllable groups in the word-group-timed analysis, accounting for 57% of all internal and post-pausal stressed syllables. There is a slight increase in duration of stressed syllables of 2-syllable groups, 158-171 ms (a difference of 13 ms) and again of monosyllabic groups, 171-190 ms (a difference of 19 ms). As the majority of stressed syllables cluster round the 158 ms mark, these slightly longer syllables seem to show an increase in duration as the number of syllables per group decreases, rather than the other way round (i.e. decrease in duration as the number of syllables per group increases). Another feature of the Spanish word-group-timed graph is the closeness of the average durations of stressed and unstressed syllables in all stress-group types, compared to the leader-timed graph. The preferred duration for the unstressed syllable is around 140 ms, only 18 ms less than that for the stressed syllable. The word-group-timed analysis, with less variation in stress-group duration shows that there is some indication of manipulation of syllable duration but on the other hand, the difference between stressed and unstressed syllables is very small. In the word-group-timed analysis, 136 of a total of 192 stressed syllables (including those of pre-pausal stress groups) were penultimate in their group, 50 occupied group final position and 6 third from last. As there is a preference in Spanish for words to be accented on the penultimate syllable, and word-group-timing shows a

significant difference from leader-timing in variation of stress-group duration, and considering also the position of the stressed syllable on the rhythm curve (Section 2.3.3.1), this second type of analysis was considered to be preferable for Spanish. The following comments therefore refer to trailer-timing for French and word-group-timing for Spanish, unless otherwise specified.

When comparing the three languages, there is a very obvious decrease in average durations of stressed syllables for English between 1 and 5-syllable stress-groups: 312-165 ms, a difference of 147 ms, whereas for French, the difference is between 257 and 205 ms, only 52 ms, and for Spanish even less, 190 - 158.5 ms, a difference of 31.5 ms. In English, average stressed syllable duration decreases (although not evenly) the more syllables there are to the stress group, in French the decrease is much more gradual and more even, but in Spanish, average durations of stressed syllables decrease between 1 and 3-syllable groups but between 3 and 5-syllable groups, remain constant. Average durations of unstressed syllables are not only remarkably constant in all three languages but are also very similar, the range of average durations for English being between 135 and 146 ms, French 124 and 145 ms and Spanish 132 and 140 ms. The English informant manipulated the duration of the stressed syllables rather than the unstressed, as a means of adjusting the duration of the stress group, especially between one and two-syllable groups. This coincides with Bolinger's and Allen's findings:

> "Bolinger (1965) feels that the isochronism in English derives from the virtually exact similarity of interstress intervals having either zero or one intervening unstressed syllables. For example, the time lapse between the stress of 'Play' and 'ball' will be the same in the sentence 'Play ball' and 'Play the ball', the vowel of 'Play' plus the following acoustic silence in the former extending over the time taken by 'the' in the latter. This finding has been supported by my own informal studies, and it is a striking fact of English timing". (Allen, 1968c: 80).

In the sample, one and two-syllable stress groups comprised 54% of the total number (including pre-pausal).

Comparing the results obtained from the data for English with those of Dauer (1980 : 318-9) reproduced in Figure 30, the decrease of average stress-group duration, considering both stressed and unstressed syllables is, on the whole, very similar, although her informant used the unstressed syllables to a greater extent than the stressed. In the present study, the average stress group durations increased from 312-733 msecs between 1 and 5-syllable stress groups, a total of 421 ms, whereas in Dauer's test, they increased from 270-705, a total of 435 ms. French and Spanish both exhibit a greater increase in average stress-group durations than English, French 257-782 ms, a total of 525 ms and Spanish 190-663, a total of 473 between 1 and 5-syllable groups. According to these results, Spanish is different rhythmically from English as there is very little variation between average durations of stressed and unstressed syllables regardless of the type of stress group. Ratios between stress groups are included in Table 28 and will be referred to later but it is worth noting that the ratios for Spanish are proportional to the number of syllables they contain, to a greater extent than those of English and French. The ratio between 1 and 5-syllable groups in Spanish is 1:3.5, French 1:3 and English 1:2.3.

In the previous section it was found that there was more variation in syllable duration in English than in French and Spanish, considering all syllables and those of internal stress groups. In a syllable-timed language, one would expect little variation between syllables and also between stress groups containing the same number of syllables whereas in a stress-timed language, one would expect there to be more

variation between syllables but not between stress groups containing the same number of syllables. In general, the results which are presented in Tables 29 and 30 show that there is less cross-language variation between stress groups of the same type than between syllables contained in the same type of group. For one-syllable groups the standard deviation is much greater in English and variation is significantly greater than in French and Spanish, $p < .05$. In two-syllable groups, variation between English and French is not significant at syllable or group level but whereas English has more variation

TABLE 29

English, French and Spanish : Noah's Ark
Standard deviations of syllables and stress groups according to stress group type

	English				French				Spanish			
N of sylls per SG	S	US	SG	N SG	S	US	SG	N SG	S	US	SG	N SG
1	80.86		80.86	9	41.04		41.04	11	35.42		35.42	8
2	87.12	57.7	88.76	34	83.85	53.45	99.78	38	52.58	40.06	60.26	45
3	85.02	58.7	101.85	46	54.34	55.92	103.83	26	36.8	54.68	75.42	37
4	102.39	44.03	99.75	11	78.1	39.8	96.92	22	35.86	49.72	81.35	24
5	55.34	58.43	88.27	4	80.76	29.07	62.35	5	42.2	41.02	36.44	8
6					37.5	38.72	91.5	2				

S = stressed; US = unstressed; SG = stress group; N = number

at syllable level, French has more at stress-group level. Spanish has significantly less variation than the other two languages at all levels. In three-syllable stress groups, there is the same kind of pattern. English has most variation at syllable level, there being more cross-language variation of stressed syllables than unstressed.

Variation levels out when the whole stress group is considered, and the order changes: French > English > Spanish. The difference between English and Spanish, and French and Spanish however is still significant, although only at the $p < .05$ level. Four-syllable groups again retain the same type of pattern, this time there being more variation in Spanish unstressed syllables and no significant difference between the languages at the level of stress group. With 5-syllable groups, of which there were only four in the English sample, there is very little variation between the languages. The general tendencies of Tables 29 and 30 can be summarized as follows: variation is greatest in English and least in Spanish, English has more variation than French at the syllable level and the same or less at stress-group level, both languages showing more variation than Spanish, and the variation between languages becomes less significant, the more syllables there are to the stress group. However, the most striking feature of the table is the small amount of variation in Spanish syllable and stress group duration compared to English and, to a certain extent, to French. Duration as a stress correlate will be discussed later in Section 3.1.1. d), but it is worth looking at Figure 32, showing average durations plus and minus one standard deviation of stressed and unstressed syllables according to the type of stress-group. Here the standard deviations of the Spanish syllables in the word-group-timed analysis very clearly cluster together when compared with those of the other languages.

3.1.1. c) Variation in stressed vowel duration according to stress group type

To examine variation in stressed vowel duration according to stress group type, syllable nuclei of internal stress groups were used (including those of post-pausal groups in the trailer-timed and word-

TABLE 30

English, French and Spanish : Noah's Ark
F tests for variance between stressed syllables, unstressed syllables and stress groups according to stress group type.

	Language with more variation	Language with less variation	Value of F	Level of significance
1-syllable groups	English	French	3.88	$p < .05$
	French	Spanish	1.34	
	English	Spanish	5.21	$p < .05$
2-syllable groups				
Stressed syllables	English	French	1.08	
	French	Spanish	2.54	$p < .01$
	English	Spanish	2.75	$p < .01$
Unstressed syllables	English	French	1.17	
	French	Spanish	1.78	$p < .05$
	English	Spanish	2.07	$p < .05$
Stress group	French	English		
	French	Spanish	2.74	$p < .01$
	English	Spanish	2.17	$p < .05$
3-syllable groups				
Stressed syllables	English	French	2.45	$p < .05$
	French	Spanish	2.18	$p < .05$
	English	Spanish	5.34	$p < .01$
Unstressed syllables	English	French	1.1	
	French	Spanish	1.05	
	English	Spanish	1.15	
Stress group	French	English	1.04	
	French	Spanish	1.9	$p < .05$
	English	Spanish	1.82	$p < .05$
4-syllable groups				
Stressed syllables	English	French	1.72	
	French	Spanish	4.74	$p < .01$
	English	Spanish	8.15	$p < .01$
Unstressed syllables	English	French	1.22	
	Spanish	English	1.27	
	Spanish	French	1.56	$p < .05$
Stress group	English	French	1.06	
	French	Spanish	1.51	
	English	Spanish	1.5	
5-syllable groups				
Stressed syllables	French	English	2.13	
	French	Spanish	3.66	
	English	Spanish	1.31	
Unstressed syllables	English	French	4.04	$p < .01$
	Spanish	French	1.99	
	English	Spanish	2.03	$p < .05$
Stress group	English	French	2	
	French	Spanish	2.93	
	English	Spanish	5.87	$p < .05$

group-timed analyses of French and Spanish respectively). These included glides and approximants when they were considered as part of the syllable nuclei according to the criteria established in segmentation (2.3.1.4, 2.3.2.4, 2.3.3.4). Syllables with no precise points for segmentation were omitted from this test. The results are presented in Table 31 and Graph 31. There is a sharp decrease in duration in English between one and five-syllable stress groups, 169-86 msecs, a difference of 83 ms, whereas for the other two languages, the decrease is less, French 144-89 ms a difference of 55 ms, and Spanish, 99-82 ms, a difference of only 17 ms, between one and five-syllable groups in each case. French shows a much greater difference than one would expect to find between one and two-syllable groups of a syllable-timed language and again between four and five-syllable groups. Spanish stressed syllable nuclei remain very constant. The graphs for leader-timing in French and Spanish do not show any general tendency and again trailer- and word-group -timing analyses appear to be more appropriate for these languages because they do show a trend for stressed syllables to decrease in duration as

TABLE 31

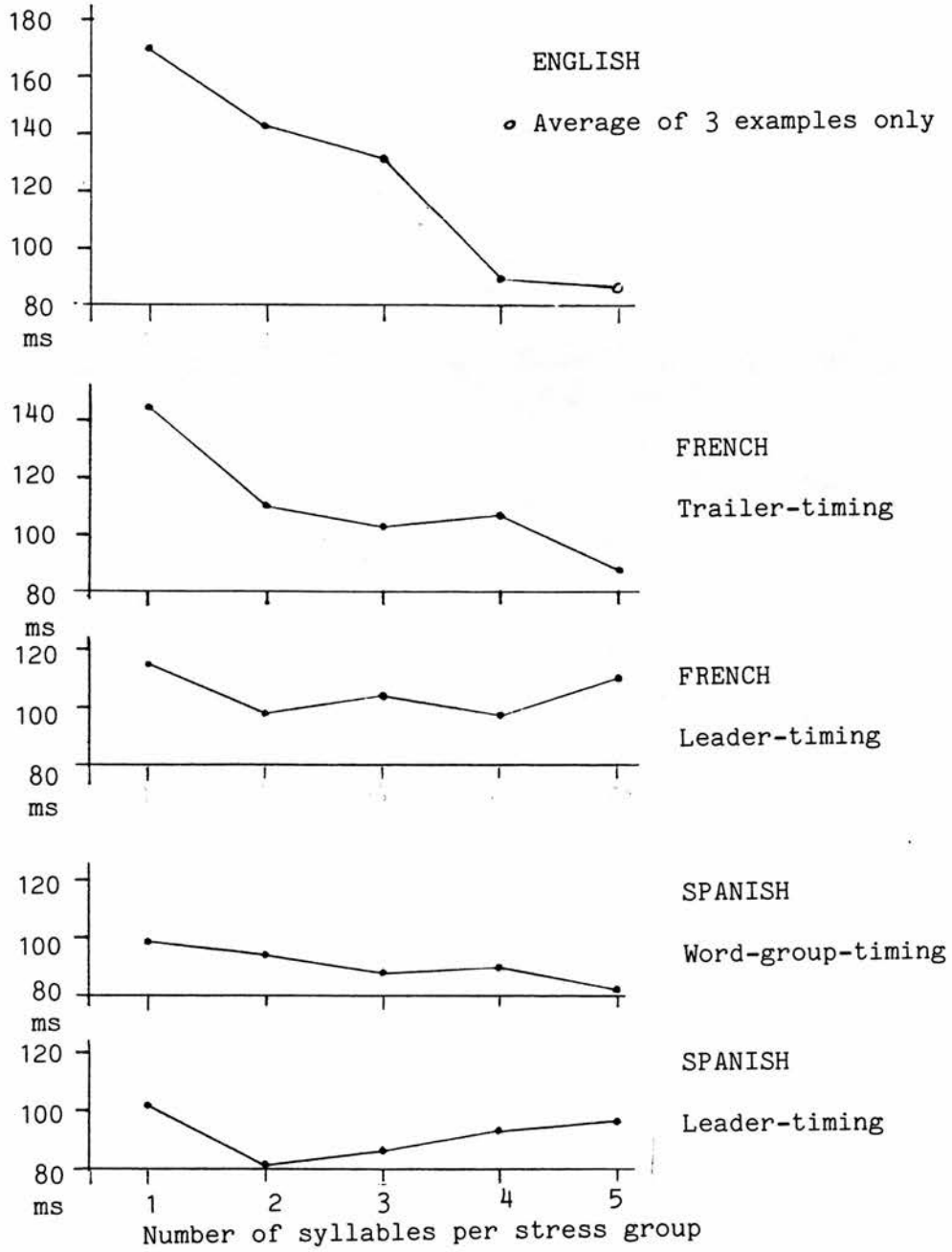
English, French and Spanish : Noah's Ark
Average duration in milliseconds of stressed syllable nuclei according to stress-group type.

	Number of syllables per stress group				
	1	2	3	4	5
English	169	141	131	89	86*
French : Trailer-timing	144	111	103	107	89
French : Leader-timing	115	98	104	98	110
Spanish : Word-group timing	99	94	88	90	82
Spanish : Leader-timing	101	81	86	93	98

* only 3 examples.

Figure 31

English, French and Spanish : Noah's Ark
Graphs of average durations of stressed syllable nuclei according to stress group type. 2 analyses for French and Spanish.



the number of syllables per stress group increases. Comparing figures 30 and 31, there is quite an obvious correlation between the languages individually. In English, the stressed syllables of 4-syllable groups were difficult to segment and only four could be averaged for syllable nuclei. These contained short vowels, hence the drop between the stressed nuclei of three and four-syllable groups. In French, stressed syllables of two-syllable groups had on average shorter vowels and longer consonants than those of one-syllable groups. In English, vowels are mainly responsible for the difference in average durations between stressed syllables, which between 1 and 4-syllable stress groups is 90 ms (Table 28) and the difference between the corresponding vowel durations, 80 ms (Table 30), so the consonants are only responsible for a difference of 10 ms. In French, as 5-syllable groups are more common than in English, these have been considered too. The difference between average stressed syllable durations in French between one and five-syllable groups is 52 ms (Table 28) and between their vowels, 55 ms (Table 30). When considering only one to four-syllable groups, the difference for the stressed syllables is 45 ms, but for the vowels only 37 ms. However, even in the second case, the consonants are only responsible for a difference of 8 ms. In Spanish the positions are reversed; between one and five-syllable group stressed syllables, there is a difference of 31.5 ms in their average durations of which the vowels are responsible for only 17 ms and between one and four-syllable groups, the difference is 31 ms for the complete syllable and only 9 ms between vowels. Differences in consonant duration are therefore responsible for 22 ms of the difference in average duration between stressed syllables of one and four-syllable stress groups. This is interesting to note as it ties up with the instability of the Spanish consonant compared to the

stability of the Spanish vowel, described in section 3.1.3, and further investigated in Chapter VI, and no doubt this feature helps to give the impression that Spanish is syllable-timed. As expected, in English the consonant is much more stable than the vowel and French lies somewhere in between, but with the vowels varying much less than in English. Further experimentation would be needed to establish this definitely but it does seem probable that if there is very little difference in syllable nuclei durations, and if the durational differences which are present, occur at syllable boundaries, one will be more likely to hear the syllables as isochronous.

3.1.1. d) Variation in syllable duration as stress correlate. Comparing average syllable durations for English, French and Spanish and standard deviations which include over 65% of the syllables in each case, the following points emerge; (Figure 32) these refer to trailer-timing for French and word-group-timing for Spanish unless otherwise specified:

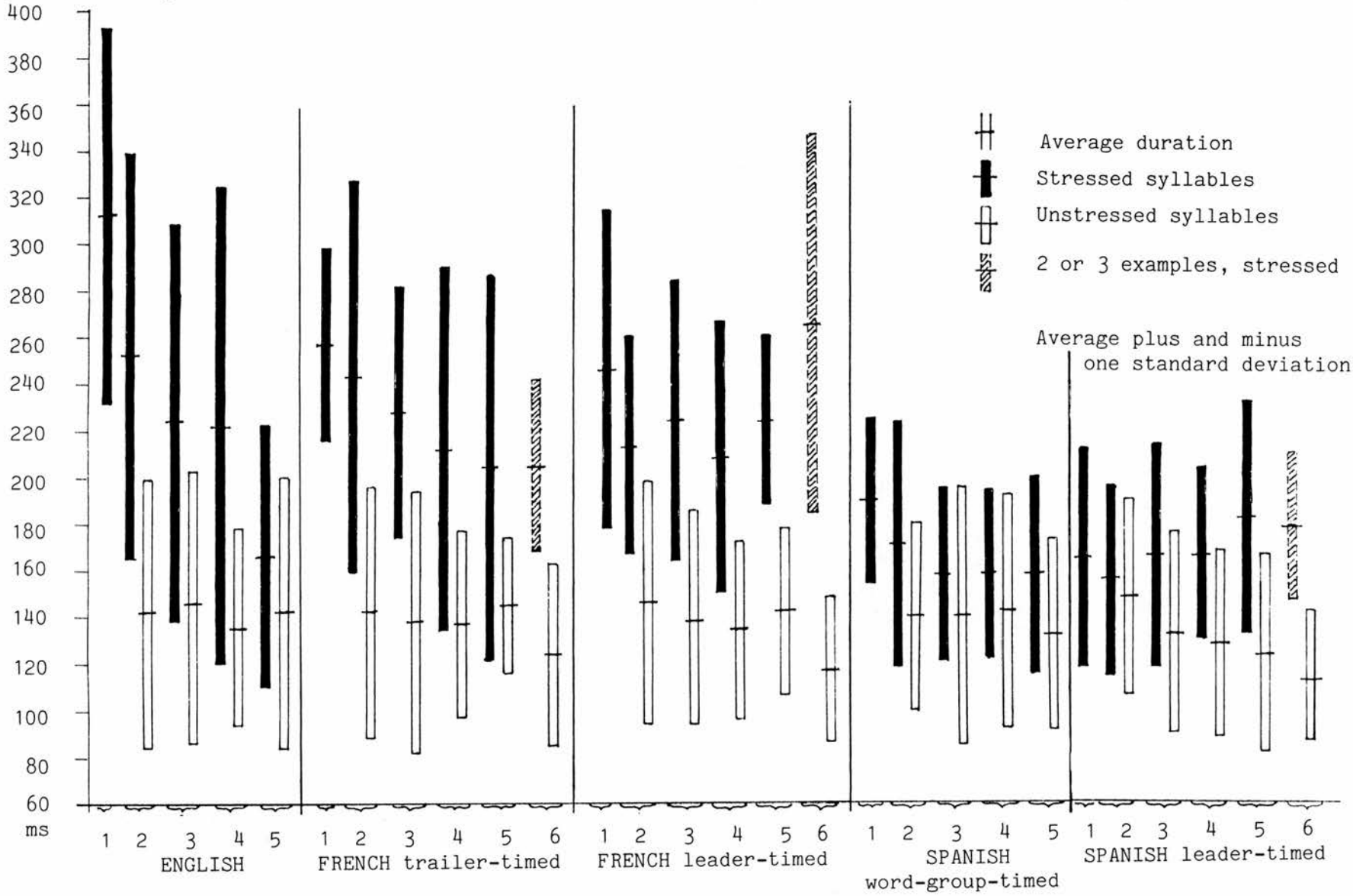
a) All average durations of stressed syllables are greater than those of unstressed.

b) Standard deviations of English stressed syllables cover a greater range of syllable durations (with the exception of S.D. French, five-syllable groups) than the other two languages.

c) Standard deviations of French stressed syllables cover a greater range of syllable durations than those of Spanish.

d) Standard deviations of Spanish stressed syllables overlap those of unstressed to a large extent for each stress group type. (Overlapping is less in the leader-timed analysis.)

Figure 32
English, French and Spanish : Noah's Ark
Average durations and standard deviations of stressed and unstressed syllables according to stress group type.



e) Standard deviations of English stressed and unstressed syllables within the same stress group type overlap each other to a greater extent as the number of syllables per stress group increases. (This does not indicate however, that English approximates to syllable timing in long groups. The syllables contained in them vary greatly in their durations e.g. "'everything that be'longs" (stress group N° 92), the measurements of the consecutive syllables are 137, 133, 275, 45 and 85 ms.)

f) Standard deviations of French stressed syllables overlap those of unstressed to a lesser extent than the other two languages.

g) Minimum syllable duration within the standard deviations is quite similar for all languages whereas maximum duration varies considerably.

Comparing the trailer-timed and leader-timed analyses for French, the graphs are quite similar for the commonest type of stress groups (1-4 syllables). In Spanish, the two graphs differ considerably, especially the standard deviations of groups of 3, 4 and 5 syllables. These overlap each other, stressed and unstressed syllables within the same group as well as across groups, to a much greater extent in the word-group-timed analysis than the leader-timed, with the exception of one-syllable groups and stressed syllable standard deviations of two-syllable groups.

A BMDP, Programme P2V analysis of variance and covariance with repeated measures was carried out on the data and the following results were obtained. Main effects differences were found to be significant between languages ($F2, 569 = 11.11$, $p < .001$) and syllables ($F1, 569 = 88.47$, $p < .001$). Interactions between languages and

syllables were calculated by means of Scheffé Tests, giving the following results:

English stressed syllables > { English, French, Spanish } unstressed syllables ($p < .01$)

French stressed syllables > { English, French, Spanish } unstressed syllables ($p < .01$)

Spanish stressed syllables > { English, French, Spanish } unstressed syllables ($p < .01$)

English stressed syllables > Spanish stressed syllables ($p < .01$)

French stressed syllables > Spanish stressed syllables ($p < .01$)

According to these results, there is a significant difference in duration between stressed syllables and unstressed syllables of all the languages examined, therefore an increase in duration acts as a stress correlate in all three languages. Average durations of unstressed syllables were similar (Table 26) so predictably no significant differences emerged but both English and French stressed syllables were significantly longer than Spanish. Spanish therefore uses duration as a stress correlate to a lesser extent than English and French as suggested in the comments on Figure 32. (For a discussion of stress correlates in Spanish see Chapter IV.) Spanish can therefore be considered to be closer to syllable-timing than French or English, but obviously objective syllabic isochrony is not present as stressed syllables are significantly longer than unstressed. Average durations and ratios of stressed and unstressed syllables (trailer-timed French, word-group-timed Spanish) are as follows:

	Unstressed syllables	Stressed syllables	Ratio
English	143 ms	240 ms	1:1.68
French	138 ms	231 ms	1:1.68
Spanish	139 ms	165 ms	1:1.19

(In the leader-timed analysis for French and Spanish which did not include post-pausal stress groups, the ratios were slightly different, 1:1.59 and 1:1.26 respectively, unstressed to stressed syllables, but this was not significant and made no difference to the results.)

Leon claims that French stressed vowels double the length of the unstressed. "Une voyelle accentuée est plus longue que les voyelles inaccentuées. La voyelle accentuée est environ deux fois plus longue que les autres." (A stressed vowel is longer than the unstressed. The stressed vowel is about twice as long as the others.) (Leon & Leon: 1971 : 66). The difference in average durations of stressed and unstressed syllables in Spanish is barely above the JND's for these figures (Chapter IV, Table 13). More varied syllable structure may account to some extent for the difference in average durations in English. In English and French, syllables of more complex structure tend to be stressed but in Spanish there is no obvious preference. The different syllable types are much more evenly distributed among stressed and unstressed syllables (Figure 33). Dauer also found this to be true of Spanish compared to English (Dauer, 1983 : 57). However, Spanish and French have a preponderance of simple CV structure syllables, Spanish 57.4% (if word final C's had been detached and allotted to the following syllable where the word initial segment was a vowel, this percentage would have been slightly higher), French 60.8%, whereas English has only 37.4% in the texts examined (Table 33). (Syllable

structure is discussed in greater detail in sections 3.1.2 a and b.) As syllables of CV structure account for a high proportion of all syllables in French and Spanish, the difference in ratios between French and Spanish stressed and unstressed syllables cannot be explained by the difference in syllable structure. This supports the claim that duration is an important stress correlate in French (3.1.1.d).

It is traditional in studies of Spanish to classify syllables into open and closed and the following figures are quoted for comparison:

TABLE 32

Average durations and ratios unstressed/stressed of non-final syllables in Spanish

Syllable type	Delattre, 1966	Olsen, 1972	Pointon, 1978	Author
Open stressed	202	178	165	146
Open unstressed	182	137	126	118
Ratio unstressed/stressed	1:1.11	1:1.3	1:1.31	1:1.24
Closed stressed	259	239	206	196
Closed unstressed	193	190	163	167
Ratio unstressed/stressed	1:1.34	1:1.26	1:1.26	1:1.17

In all cases the average durations of stressed syllables are longer than the unstressed of similar structure but the difference is small and comparing closed unstressed with open stressed, the former are on average longer in two of the studies and practically the same in the other two. It would seem therefore, that the segmental structure of the syllable in Spanish determines its duration to a greater extent than whether they are stressed or unstressed. Pointon also found this

to be true of Spanish and discusses it at greater length (Pointon, 1978).

In conclusion, Spanish exhibits little difference in average durations of stressed and unstressed syllables and therefore maintains syllabic isochrony more so than French. French on the other hand, uses an increase in duration as an important stress correlate. In English, stressed syllables are on average much longer than unstressed but this difference is partly due to the more complex structure of stressed syllables and may be sacrificed to maintain stress-timing as in five-syllable stress groups (Figure 32) where average durations and standard deviations are almost equal for both types of syllable.

3.1.2 Syllable Structure

3.1.2. a) Syllable structure in general

In languages which exhibit more homogeneity of syllable structure such as French and Spanish, where CV type syllables account for 60.8% and 57.4% of all syllables respectively (Table 33), and assuming that segments have a limited minimum and maximum duration, one would expect the impression of syllable timing to be greater than for languages of more varied syllable structure. English permits up to eight phonological segments per syllable C(0-3) VC(0-4), French up to six C(0-3) VC(0-2), and Spanish up to five C(0-2) VC(0-2) if the syllable is not word final and four if it is C(0-2) VC(0-1). However, in the texts examined, the more complex syllables of English account for a small proportion of the total number, 10% of all syllables in both English and French contained consonant clusters and 7% in Spanish (Table 34). But even within the structures which are commonest in all three languages, English presents much greater variation. The most obvious difference is between open and closed syllables, the majority being closed in English, 52.7%, and open in French and Spanish, 73% and 65%

respectively. This is carried principally by CV structure syllables as mentioned above, but there is also a big difference in percentages of VC type syllables, English 16.3%, French 2.0% and Spanish 5% Arresting and releasing consonants of stressed and unstressed syllables within internal stress groups were measured for English and the average durations of consonants permitted in all positions are presented in Table 35 (p.213). Although there is insufficient data, it is clear that releasing consonants of stressed syllables are longer than the others (compare with figures for Spanish, Chapter IV). This was also found to be true in a study of consonant duration in American English by Umeda (Umeda, 1977). The only consonant which occurred frequently enough to obtain averages based on more than five examples was /t/ but the decrease in average duration from stressed releasing to unstressed arresting would probably be typical of the other stop consonants, were there sufficient data to show it. On the whole however, arresting consonants are shorter than releasing and this, plus the tendency in English for arresting consonants to suffer more modification than releasing (Section 3.1.4.6) would account for considerable variation between syllable durations of CV and VC structure. There are also slightly more syllables of the structures V and CVC in English, 7.1% and 29.7% than in French, 6.2% and 21% and Spanish 3.2% and 27.2% (except Smith in Dauer, French V = 10%) (Table 34). Spanish and French therefore are similar in their overall distribution of syllable structures whereas English is much more varied.

The order of frequency of occurrence is the same for all three languages for CV and CVC syllables (Table 34). However, these account for only 67% of all syllables in English (Dauer 64%), compared to 82% in French (Smith 75%) and 84% in Spanish (Dauer 80%, Guerra 72%) which

TABLE 33

English, French and Spanish : Noah's Ark
Syllable structure : all syllables

English

Open Syllables		Closed Syllables			
V	7.1%	VC	16.3%	CCVCC	0.2%
CV	37.4%	CVC	29.7%	CVCCC	0.5%
CCV	2.5%	VCC	0.2%	CVCC	3.6%
CCCV	0.2%	CCVC	2.0%	CCCVCC	0.2%
47.3%		52.7%			

Stressed syll:38.3%; Unstressed syll:61.7%

French

Open Syllables		Closed Syllables	
V	6.2%	VC	2.0%
CV	60.8%	CVC	21.0%
CCV	6.0%	CVCC	2.0%
		CCVC	2.0%
73%		27%	

Stressed syllables : 34.4%
Unstressed syllables : 65.6%

Spanish

Open Syllables		Closed Syllables	
V	3.2%	VC	5.0%
CV	57.4%	CVC	27.2%
CCV	4.4%	CCVC	2.8%
65.0%		35%	

Stressed syllables : 33.8%
Unstressed syllables : 66.2%

Note: In English, syllabic consonants [l̩, m̩, n̩, ŋ̩] and diphthongs were counted as V. For segmentation see Sections 2.3.1.4, 2.3.2.4, and 2.3.3.4.

TABLE 34

Syllable types in order of frequency of occurrence
in English, French and Spanish (rounded off)

English		French		Spanish		Spanish[1]	
CV 37%	67%	CV 61%	82%	CV 57%	84%	CV 60%	86.5%
CVC 30%		CVC 21%		CVC 27%		CVC 26.5%	
VC 16%		V 6%		VC 5%		CCV 4%	
V 7%		CCV 6%		CCV 4%		VC 3.5%	
CVCC 4%		VC 2%		V 3%		V 2.5%	
CCV 3%		CVCC 2%		CCVC 3%		CCVC 3%	
CCVC 2%		CCVC 2%					
CCCV, VCC, CCVCC, CVCCC, CCCVCC	1%						
Syllables of 4 or more segments							
7%		4%		3%		3%	

Most frequently occurring syllable types
(adapted from Dauer, 1983 : 56)

English		Spanish		French[2]	
CV 34%	64%	CV 58%	80%	CV 56%	75%
CVC 30%		CVC 22%		CVC 19%	
VC 15%		CCV 6%		V 10%	
V 8%		V 6%		CCV 7%	
CVCC 6%					

Spanish[3]	
CV 53%	72%
CVC 19%	
V 9.5%	
VC 8%	
CVV 3%	
CCV 3%	

1. Traditional analysis of Spanish allotting word final detachable consonants to following syllable.

2. Smith in Dauer for a reading of colloquial French containing 124 syllables.

3. Rafael Guerra (1981) in Quilis, 1981 : 309.

again shows a tendency for less variation in French and Spanish. The next most frequently occurring syllable type in English, VC makes up 16% (Dauer, 14.5%) whereas the percentage is much smaller for French and Spanish. The difference between these results for Spanish and Dauer's is partly due to the difference in criteria for syllable division. Dauer followed the traditional method for Spanish assigning word final inter-vocalic consonants to the following syllables. On checking the data of this study according to the traditional method, it was found that the difference was small. Syllables of CV structure were the most affected and increased by 3% (Table 34), whereas syllables of VC structure decreased by 1.5% making the three most common syllable types, CV, CVC and CCV. However, syllables of the type CVC did not decrease by much so CV and CVC type syllables now account for 86.5%. Guerra's CVV figure should be added to CV and CVC making the percentage 75% in order to compare with Dauer's and the present author's figures.

Syllables of complex structure, containing four or more segments (Table 34) were more frequent in English - 7% compared to French 4% and Spanish 3%. However, the difference is not as great as might be expected, considering the possibility of different combinations in English (Gimson, 1970:239-255)and this informant avoided complex releasing consonant clusters where possible, e.g. "rounds" was realized as [ra@nz].

The main differences between Spanish and English as regards syllable structure are therefore a preponderance of open syllables in Spanish and closed in English, the most frequent syllable types make up a greater proportion of the total number in Spanish than in English, and there are fewer syllables of complex structure (4 or more segments) in

TABLE 35

Average durations in ms of arresting and releasing consonants of syllables contained in internal stress groups according to syllable type: English, Noah's Ark (consonants in clusters not included).

phoneme	Releasing		Arresting	
	of stressed syllable	of unstressed syllable	of stressed syllable	of unstressed syllable
p	99	(78)	(72)	48
t	95	60	53	38
k	90	70	(44)	(49)
b	71	46	(57)	-
d	-	43	(50)	37
g	(35)	(30)	-	(48)
tʃ	(133)	-	(93)	(79)
dʒ	-	-	-	(86)
f	94	77	-	(62)
θ	(83)	(79)	-	-
s	104	(79)	(89)	(81)
ʃ	(109)	77	-	-
v	(39)	(52)	-	42
ð	(46)	42	-	(41)
z	(58)	(45)	-	53
l	57	(45)	(86)	(73)
m	95	(86)	(81)	87
n	85	73	(81)	78

( ) = less than 5 examples.

Spanish. A language which has a high proportion of syllables of simple structure (CV) gives the impression that the syllables are of equal (or near equal) duration. Languages which have been classed as syllable-timed all have a high proportion of syllables of simple structure, e.g. French, Yoruba, Japanese, and it would seem that this characteristic is essential for a language to be perceived as syllable-timed (Smith, 1976). From this data, Spanish exhibits a preference for simple syllable types to about the same or a greater degree than French and therefore has this characteristic in common with other languages classed as syllable-timed. Dauer (1983 : 56-57) and den Os (1983 : 18-19) consider these differences in syllable structure to be of great importance in the perception of rhythmic differences between languages.

3.1.2. b) Syllable structure according to position in stress group (all syllables)

The unstressed syllables by far outnumbered the stressed for all languages, but the ratios were different. In English, the ratio stressed to unstressed was 1:1.6, i.e. 5 to 8, but in French and Spanish the unstressed syllables almost doubled the stressed in the texts examined, stressed to unstressed 1:1.9 for French and 1:1.96 for Spanish. The actual numbers of stressed and unstressed syllables according to syllable type are contained in Table 36. As the unstressed syllables outnumber the stressed and a higher proportion of these are of CV structure in French and Spanish than English (44% of the total number in French, 38% in Spanish compared to 24% in English), this will help to give the impression of syllable-timing in French and Spanish, at least to a native speaker of English.

Figure 33 and Table 37 show the various syllable types as percentages of the whole number of stressed syllables and unstressed syllables

TABLE 36

English, French and Spanish : Noah's Ark
Numbers of stressed and unstressed syllables
according to syllable structure (all syllables)

Syllable Structure	English		French		Spanish	
	Stressed	Unstressed	Stressed	Unstressed	Stressed	Unstressed
V	2	29	1	27	4	14
VC	14	58	1	8	9	19
CV	57	108	74	200	110	215
CVC	62	69	48	48	56	98
CCV	9	2	16	11	5	20
VCC	1					
CVCC	12	4	6	1		
CCVC	7	2	9	1	7	9
CCCV	1					
CCVCC	1					
CVCCC	2					
CCCVCC	1					
N =	169	272	155	296	191	375
N =	441		451		566	

respectively. What is immediately clear from the histograms is that a higher proportion of the examples of each syllable type are stressed as the syllables increase in complexity in English and French, but to a much lesser extent in Spanish, in fact hardly at all. A higher percentage of CCV type syllables (which can be considered complex in Spanish) are unstressed (5%) than stressed (2.5%). In English and French, the majority of V, CV and VC syllables are unstressed whereas in Spanish the percentages of CV and VC are about the same, CV stressed 58%, unstressed 57%, VC stressed and unstressed 5%. Even for CVC syllables the difference is small, stressed 29% to unstressed 26%, compared to English, stressed 37%, unstressed 25% and French stressed 31%, unstressed 16%. Dauer's percentages for Spanish and English have been included for comparison (Table 37). The results are similar for

TABLE 37

English, French and Spanish : Noah's Ark
Most frequently occurring stressed and unstressed syllables according to syllable structure (rounded off)

English				French				Spanish			
Stressed		Unstressed		Stressed		Unstressed		Stressed		Unstressed	
CVC	37%	CV	40%	CV	48%	CV	68%	CV	58%	CV	57%
CV	34%	CVC	25%	CVC	31%	CVC	16%	CVC	29%	CVC	26%
VC	8%	VC	21%	CCV	10%	V	9%	VC	5%	CCV	5%
CVCC	7%	V	11%	CCVC	6%					VC	5%
CCV	5%										

Most frequently occurring stressed and unstressed syllables (Dauer, 1983 : 57)

English				Spanish			
Stressed		Unstressed		Stressed		Unstressed	
CVC	35%	CV	38%	CV	53%	CV	61%
CV	28%	CVC	27%	CVC	24%	CVC	22%
CVCC	13%	VC	20%	CCVC	12%	V	7%
CCVC	6%	V	10%	CCV	9%	CCV	5%

the two most frequently recurring syllable types in each language. She also found that the segmental composition of syllables in English tends to reinforce the difference between stressed and unstressed as most of the unstressed syllables were composed of a consonant plus an inherently short vowel, compared to Spanish in which most unstressed syllables contained open or half open vowels which are inherently long whereas stressed vowels were more evenly distributed between open and close (Dauer, 1983 : 57). She suggests that "...syllable structure and stress are more likely to reinforce each other in a stress-timed language than in a syllable-timed language." (Dauer, 1983 : 56). If that is the case, French has this characteristic in common with stress-timed languages.

As the duration of syllables increases the more segments they contain, the fact that French stressed syllables are more complex will account to a certain extent for the difference in durations between French stressed and unstressed syllables. It may not be true then, that this is a general characteristic of stress-timing only as French certainly gives the impression of not being stress-timed. This is however based on this study alone and although Figure 33 presents a very clear correlation between complexity of syllable structure and stress, I feel that more research in French and other languages considered as syllable-timed would need to be carried out in order to come to any conclusion. It does indicate however, that there are important rhythmic differences between French and Spanish, although a native speaker of French when speaking Spanish misplaces the stress, not on the more complex syllable, but noticeably on word final syllables. On the other hand, French and English differ in that syllables are distributed amongst the various syllable types more evenly in English than in French. CV syllables alone in French

account for 68% of all unstressed syllables and 48% of all stressed, whereas the percentages in English are 40% and 34% respectively. Individual segments will be discussed in Section 3.3.a, but it is worth mentioning here that French short vowels such as [ə] in unstressed syllables of the type [lə] and [də] are generally longer than English schwa in words like [tə] [ðə] by about 20 ms, so within CV type syllables there is less variation of duration in French than English.

Accepting that syllable-timed languages would be less likely to exhibit a preference for complex syllable structure in stressed syllables, as the resulting increase in duration would affect isochronicity, Spanish fits the bill, showing a remarkably symmetrical distribution of syllable types in stressed and unstressed syllables within the central tendencies. Only CV and CVC syllables account for more than 5% of stressed syllables (VC was 4.7%) and to these have to be added VC and CCV structures for unstressed syllables, although the latter represent only just over 5% each of the total.

We can therefore conclude that Spanish syllable structure and distribution of syllable types reinforces the tendency towards equal syllable durations which syllable-timing implies, but the above description raises doubts with regard to French and the assumption that only stress-timed languages show a preference for more complex syllable structures in stressed syllables.

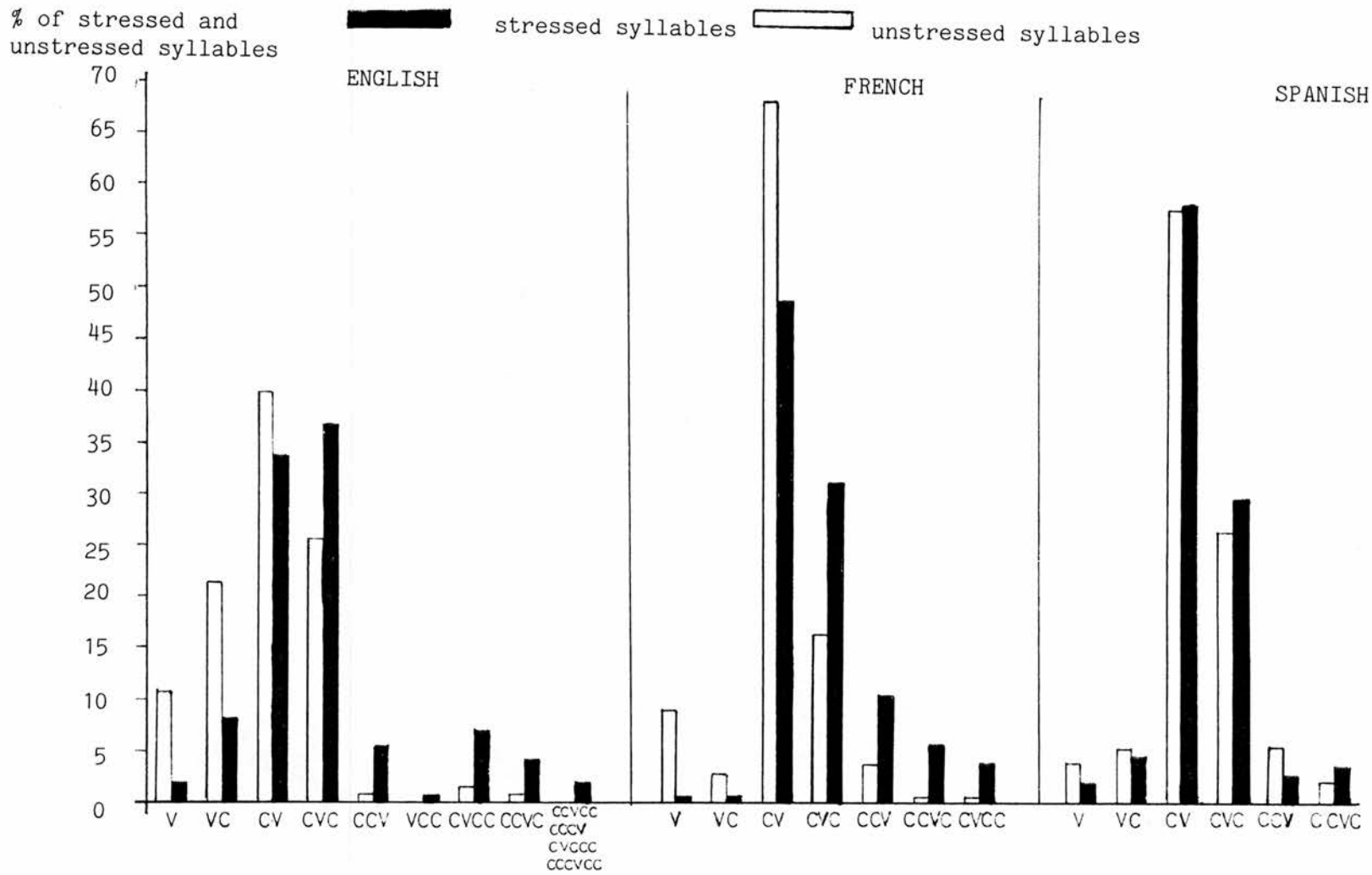
3.1.3 Segmental Modification

3.1.3 a) Vowel Modification

In a stress-timed language such as English, continuous voiced sounds, expecially unstressed vowels, are often obscured in some way by centralization or shortening, or they may be omitted altogether, thus

Figure 33

English, French and Spanish : Noah's Ark
Histograms of syllable structure in stressed and unstressed syllables



contributing to the compression effect which is typical of stress-timing. In syllable-timed languages, one would not expect vowels to undergo such modification. In Spanish, which has a simple system of only five vowel phonemes (excluding diphthongs which are considered as biphonematic (Alarcos Llorach, 1974: 151-2), each vowel is recognizable as such in both stressed and unstressed syllables which is, indeed, necessary as comprehension depends to a large extent on the vowels. Some unstressed vowels are centralized especially when contained in syllables adjacent to stressed syllables but their quality is never obscured completely. In descriptions of the phonetics of Spanish and in allophonic transcriptions, these vowels are often referred to and transcribed as lax. Whilst it is clear that lax means non-peripheral, that the position of the highest part of the tongue in a lax variety of /i/ is slightly lowered and retracted, and that for /a/ it would be slightly raised, I still feel that lax and tense are useful terms for Spanish unstressed and stressed vowels respectively. The term centralized seems to imply a loss of quality which is unacceptable in Spanish. The difference in quality is very slight between, for example, a tense /i/ and a lax /i/, less than that between English /i/ and /ɪ/. In English, it is possible to decipher a text in phonemic transcription, substituting all the vowels for schwa [ə][6], but not so in Spanish. For example, final unstressed vowels denote gender, "niño, niña" (boy, girl) and also distinguish two persons of the present tense "quiero, quiere" (I want, he/she wants), the present subjunctive "quiera", two persons of the past tense "quise, quiso" (I wanted, he/she wanted) and many unrelated nouns "caza" (chase, hunt), "cazo" (cooking pot). Personal pronouns "yo, tu, el" etc. are usually omitted in conversation. To a native speaker of English, the impression is that all Spanish vowels are tense, whereas in English, the

6. This exercise was successfully performed by Venezuelan students of English at the University of Carabobo, although with some difficulty.

impression is of alternating peripheral and centralized vowels.

Stressed vowels have already been examined (Section 3.1.1.c, Figure 31) and it was found that the variation in average durations for Spanish was negligible compared to that of English. One would also expect greater variation in duration of unstressed vowels in English. Some unstressed vowels of similar quality were examined in the three languages and the results presented in Table 38. Comparing English [ə] and French [ə], English [ə] is shorter on average and shows slightly more variation according to the standard deviation but the difference is not significant. Not included in the table, however, are syllabic consonants which are sometimes preceded by a very short [ə] and cases where it was impossible to segment the vowel. In both languages [ə] was the most common unstressed vowel. Comparing English

TABLE 38

English, French and Spanish : Noah's Ark
Unstressed vowel duration in ms

	English			French			Spanish		
Vowel	[ɪ]	[ə]	[i]	[ɛ e]	[a]	[ə]	[i]	[e]	[a]
Average Duration	74	68	65	64	69	74	58	62	74
Standard Deviation	20.33	20.96	14.09	16.82	19.5	19.81	14.1	14.25	19.5
N	45	67	13	41	32	45	20	71	56

[ɪ] and French and Spanish [i], English [ɪ] is longer on average and has more variation. An F test showed that this was significant in both cases, English > French, $F = 2.08$, $p < .05$, English > Spanish, $F = 2.08$, $p < .05$. French [ɛ, e] and Spanish [e] have similar average durations and French more variation but this was not significant. [e] was the commonest unstressed vowel in Spanish. Spanish and French [a]

are both longer on average than the other unstressed vowels which is to be expected, open vowels being intrinsically longer than close. They also have greater variation but cannot be compared with English as there were no instances of unstressed [a] in the text analysed. English unstressed vowels show greater variation on the whole but the differences are not large enough to be very convincing. As mentioned above (Section 3.1.1.b), the English informant manipulated stressed vowel duration rather than unstressed. Table 38 however does show similarity between French and Spanish unstressed vowels of the same type both in average durations and variation. The differences in average durations in Spanish between [i], [e] and [a] are probably due to intrinsic duration, 4 ms between [i] and [e] and 12 ms between [e] and [a], making a total difference of 16 ms between a close vowel and an open vowel. (The informant produced a very close [e].) This corresponds to Elert's findings for Swedish (Elert, 1964, in Lehiste, 1970 : 18). The French informant on the other hand produced a very open [i], common in Northern France, especially Paris, which could account for the almost identical average durations of French [i] and [ɛ/e]. There were very few instances of unstressed [i] in the French text. It would seem therefore that intrinsic duration differences are responsible for the differences in average durations of unstressed syllables in French and Spanish, rather than rhythmic constraints.

Traditional phonemic analyses of English always include the "weak" forms of function words (where the vowel is usually reduced to [ə], [ɪ] or is elided), and syllabic consonants [m̩, n̩, ŋ̩, l̩]. Apart from these, the following instances of vowel modification were observed in the text analyzed, [ð] for [ð ə] in "took the floor" [tʊʔðflɔ] (stress group 8), omission of [ə] before and after [r] in "vulnerable" [vʌlnr̩βl̩] (stress group 36) and before [v] in "some of our" [sʌmv̩ɑə] (Stress group 98).

In French, vowels were often omitted, and less frequently added, forming an extra syllable. Advocates of syllable-timing for French would no doubt explain this as an attempt to avoid very long or very short syllables. However, the majority of examples in the text examined do appear to follow Wenk and Wioland's "Rhythmic Discharge Principle" which states that "the tendency to maintain a pre-established rhythm will influence a speaker to produce successive groups of equal or nearly equal syllable count" and their "Least Syllable Principle" which states that "in order to maximalize their chances of communicating effectively, speakers will tend to produce consistently small rhythmic groups". (Wenk and Wioland, 1982 : 206). The examples are listed as follows:

N° of eg	Type of modification		Orthography	Transcription	Stress group N°
1	elision	[ə]	tout le monde	[tulmõd]	5
2	addition	[ə]	maître de lui	[mɛtRədəlɥi]	65
3	elision	[ə]	tout ce qui me concerne	[tuskimkõsɛRn]	75, 76
4	addition	[ə]	viande	[vjɑ̃də]	86
5	elision	[ə]	qui ne leur sont pas	[kinlœRsõpa]	87
6	elision	[y]	pourquoi tu as la tête	[t͡ʃ alatɛt]	91
7	reduction	[i]	qui avait	[kjavɛ]	96
8	elision	[ə]	vous me faites	[vumfɛt]	129
9	elision	[ə]	beaucoup de peine	[bokutpɛn]	130
10	reduction	[i]	qui accueillirent	[kjakøjiR]	143
11	addition	[ə]	sans cette pluie	[sɑ̃sɛtəplɥi]	150

In the first example, [tul] forms a very long syllable, 295 ms. The two syllable durations resulting from [tu lə] would no doubt have been closer to the average for unstressed syllables. The addition of [ə] in N° 2 is explained by the fact that "maître" is followed by a voiced

consonant. Number 3 follows both principles. If [ə] had been included it would have produced a one-syllable stress group followed by a 5-syllable group ['tu sə ki mə kõ 'sɛRn]. As it is, the whole rhythmic sequence contains three groups of 2, 1 and 3 syllables respectively. Again the syllable [kim], 200 ms, is much longer than the average for unstressed syllables. There may be a very slight pause after "viande", number 4, which would explain the presence of [ə] and the length of [də], 296 ms. The fifth example follows the Rhythmic Discharge Principle. Both stress groups of that sequence contain four syllables [kin loeR sõ paz / zɛ̃ ðis pa sabl] and in the sixth example, syllables are reduced to three in the group which interferes less with equal syllable count for successive groups, syllable numbers per group in the rhythmic sequence being 2, 2, 3 and 2 (stress groups 89-92). In examples 8 and 9, both affected syllables are very long [vum], 180 ms and [kut] 247 ms so possibly both principles are being followed. The rhythmic sequence contains three groups of 2, 3 and 3 syllables respectively. Again [kja] in the tenth example is very long, 280 ms and cannot be explained by the avoidance of two short syllables. The example which illustrates best the Rhythmic Discharge Principle is the eleventh where a syllable is added thus forming two stress groups in the sequence of 4 and 5 syllables each. Also the previous stress group has 7 syllables, all rather short which may have influenced the inclusion of [tə] (stress groups 149-151). Wenk and Wioland tested their Rhythmic Discharge Principle in a corpus of spontaneous spoken French and the result was significant: the speaker did string together groups of equal or nearly equal numbers of syllables (Wenk and Wioland, 1982 : 212-3).

In Spanish, apart from sinalefa or diphthongs formed by consecutive vowels across word boundaries, there were no instances of vowel

modification as far as manner of articulation was concerned.

Delattre measured vowel reduction in English, French and Spanish by means of motion-picture X-rays to give the visible positions of the articulators and at the acoustic level by spectrograms. He found that reduction was greater in English than French and greater in French than Spanish. The resulting diagrams are reproduced here in Figures 34 and 35 (Delattre, 1981 : 63-93). The type of data used were vowels in medial positions in such words as "achican/achicaban" in Spanish in which [i] was examined. Possibly if word final stressed and unstressed vowels had been compared, such as /a/ in "gana'ra, ganara", there may have been more difference, according to Wenk and Wioland's theory of the rhythm curve (Section 2.3.3.1).

This characteristic of Spanish, having clear cut vowels, perhaps more than any other, gives the impression of syllable-timing, particularly to native speakers of languages where unstressed vowels are modified. In teaching English pronunciation to native speakers of Spanish, one of the greatest difficulties to overcome is the use of 'strong' forms for every vowel. Usually, if an acceptable English rhythm can be achieved, that is if the learner can establish the English "foot", led by its stressed syllable, independently of word boundaries, the weak forms and syllabic consonants "fall into place" so to speak. Conversely, if strong forms are produced, the impression is that the rhythm is immediately lost. Native English speakers, who impose their stress-timed rhythm on Spanish, tend to centralize all unstressed [a], [i] and [u], diphthongize [o] and [e] and centralize [e] in certain contexts, especially word final syllables closed by [r] or [n]. Thus many oppositions may be lost, for example "pueden" (they can) and "puedan" (present subjunctive of can) become [pweɪdən] or [pweɪdn̩] and

Figure 34

Articulatory charts of vowel reduction in English, French and Spanish (Delattre)

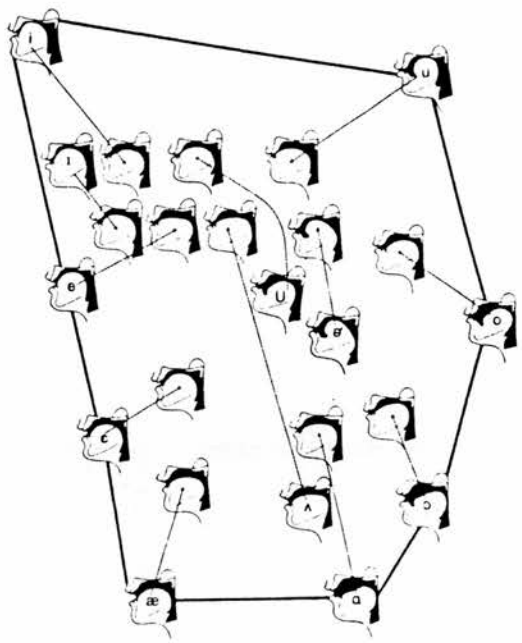


Figure 3. An articulatory chart of vowel reduction in English. The X-ray profiles showing tongue centering of unstressed vowels are placed according to the acoustic chart.

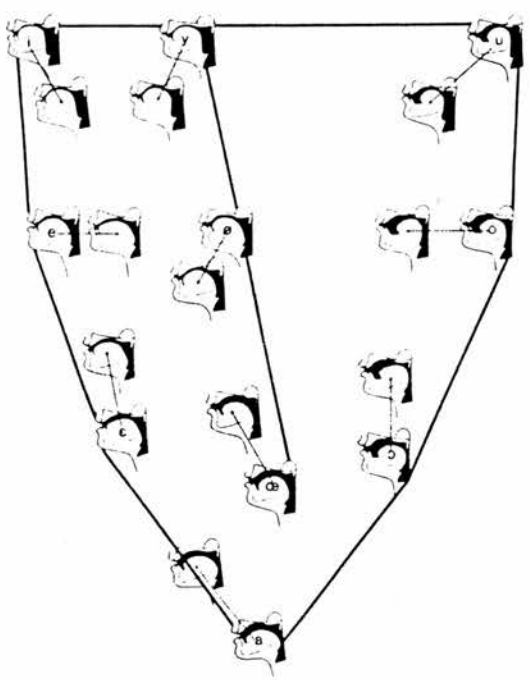


Figure 5. An articulatory chart of vowel reduction in French. The X-ray profiles showing tongue centering of unstressed vowels are placed according to the acoustic chart.

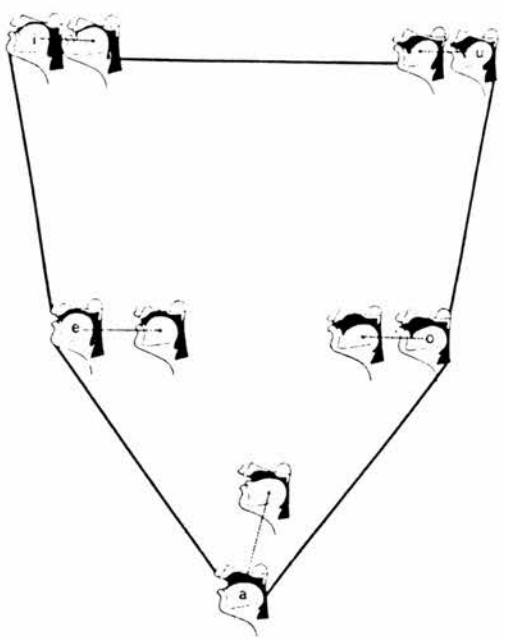
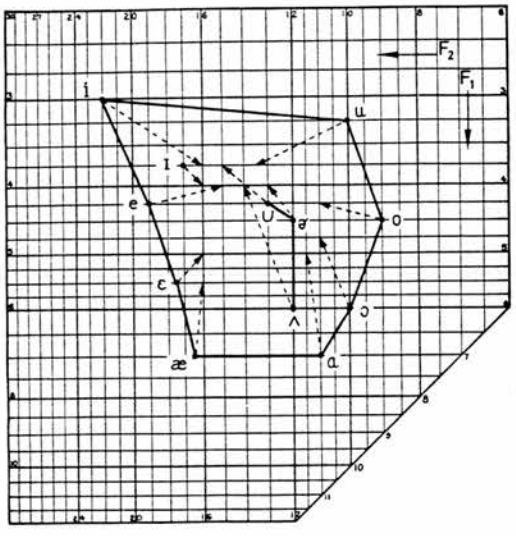


Figure 9. An articulatory chart of vowel reduction in Spanish. The X-ray profiles showing tongue centering of unstressed vowels are placed according to the acoustic chart.

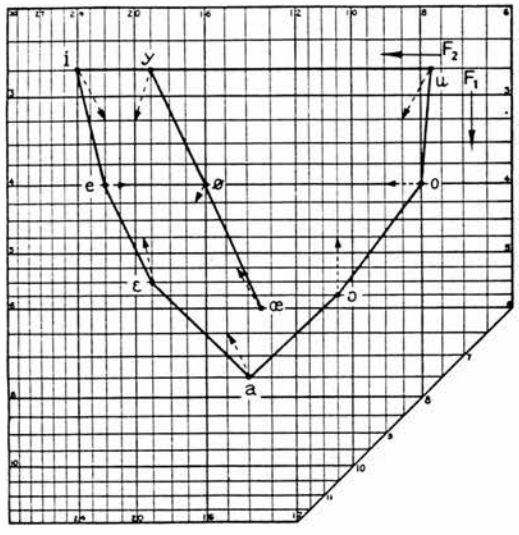
Reproduced from Delattre, 1981 : 79, 85, 90.

Figure 35

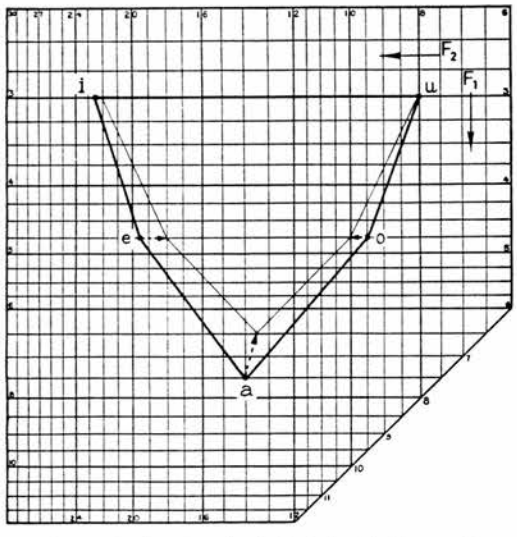
Acoustic centring of unstressed vowels in English, French and Spanish (Delattre)



. An acoustic chart of vowel reduction in English. The acoustic centering of unstressed vowels is shown by the length and direction of broken lines.



. An acoustic chart of vowel reduction in French. The acoustic centering of unstressed vowels is shown by the length and direction of broken lines.



. An acoustic chart of vowel reduction in Spanish. The acoustic centering of unstressed vowels is shown by the length and direction of broken lines.

A comparison of the acoustic centring of unstressed vowels.

Reproduced from Delattre, 1981 : 77.

stressed syllables sound far too prominent. Again, the most efficient method of correction is by paying attention to the rhythm, rather than the individual sounds.

The weakening of vowels in unstressed syllables is a characteristic of English but need not apply to all stress-timed languages. In colloquial Arabic for example, which is considered heavily stress-timed, unstressed vowels may be slightly centralized but do not change their quality to the same degree as in English weak forms (Zahida Chebchoub, personal communication).

Some vowel reduction occurs in Japanese, classed as syllable-timed (or more precisely mora-timed), where /u/ is devoiced in a voiceless environment, e.g. /desu̥ka/. "The s element might be said to swallow up the v element so that the whole syllable is pronounced with a sibilant" (Smith, 1976 : 6 in Dauer, 1980 : 339). Exactly the same process occurs in English, in words such as "necessary" [nɛs̬sɹɪ] or the expression "she's a sweet girl" [ʃiz̬switgɜl]. One cannot say that all stress-timed languages have weak unstressed vowels or that all syllable-timed languages don't. Probably each language derives its rhythmic structure from different phonetic characteristics although the rhythmic impression may be similar. As far as English and Spanish are concerned however, it is true to say that the subjective impression of the rhythms of these languages is intimately linked to the quality and duration of their vowels.

3.1.3. b) Consonant modification

In Spanish, vowels seem to retain their distinctness at the expense of the consonants. In Section 3.1.1.c, it was found that the decrease in average stressed syllable durations between one to five syllable stress groups was carried principally by the consonants. In traditional phonemic analyses /b/, /d/ and /g/ are realized as fricatives

or approximants in all environments except utterance initial and when preceded by a homorganic nasal or lateral. Spanish has a strong preference for CV structure syllables and avoids consonant clusters wherever possible. Although the phonology permits syllable-final clusters of two consonants word medially, these will very rarely be realized as two segments, e.g. "transcribir" (transcribe) would normally be realized as [traskriβir], not [transkriβir], "excepto" (except) as [esθepto] or [esepto], not [eksθepto]. In a rather 'muffled' recording of Spanish, many of the consonants seem to disappear altogether. This is not the case with English, where, although there may be some modification, syllable-initial consonants are usually distinctly articulated and can be referred to as tense compared to Spanish consonants in this position. Although this has not been proved experimentally, English syllable-initial consonants appear to involve greater muscular tension, firmer contact in the case of stop consonants and a narrower articulation channel in the case of fricatives (see Catford, 1977 : 199-204 for a discussion of the tense/lax parameter in consonants).

Referring to the syllable in perceptual terms as being made up of two parts, prominent and less prominent, one has the impression that the most prominent part of the syllable is reached on the vowel in Spanish, not the releasing consonant, and that the reverse occurs in English. The fact that syllables with no releasing consonants are frequently initiated with a glottal closure in English, especially when stressed, but not in Spanish, is possibly a symptom of the difference between the languages in articulatory tension at the level of syllable. English consonants carry more phonological weight than Spanish consonants. An English native speaker usually has difficulty in understanding Spanish in the early stages of learning because he

has not developed any phonetic empathy for the language. Apart from other suprasegmental factors, an important blockage is that he retains his expectation of syllable-initial consonant tension which does not exist and he is therefore out of phase, as it were. Once the transference of empathy has been achieved and vowels are given their proper status, predominating over consonants, the learning process becomes much easier. As mentioned above in Section 3.1.3.a, the vowel/rhythm relationship in both languages is of extreme importance and apart from considering durational differences, Spanish could be classified as a consonant-reducing language as opposed to English, a vowel-reducing language.

French consonants do not undergo the same type of modification as Spanish. Closures for stop consonants are usually complete, even when voiced, apart from the exceptions listed below. If consonants are modified, CV structures are usually retained as in "je ne sais pas" realized very frequently as [ʃɛpa] in Northern France. In the texts analyzed, closures for stop consonants were longer than in Spanish and more cases of aspiration following voiceless stops were observed. The subjective impression, listening to French, is of syllable initial tension which is more akin to English. However, in all three languages, there were instances of consonant modification which would not be included as typical allophones in traditional analyses. They are listed below. Stressed syllables are marked ' and relevant segments underlined.

English

N° of eg	Type of modification	Orthography	Transcription	N° of stress group
1	elision	my friends	[maɪ'frɛn̲z]	11
2	stop → approximant	for examples	[fəɾɪɣ'zɑmplz]	14, 15
3	elision, stop → approximant	What does the	['wɒð̲ɐzðə]	19
4	elision	Aren't there many	['ɑn̲ð̲ə'mɛnɪ]	33
5	stop → approximant	big as	['bɪɣəz]	46
6	elision	round like a	['raʊ̯n̲laɪkə]	49
7	stop → approximant voiceless → voiced	absolutely sure	['absəlʊ̯ð̲lɪ'ʃʊə]	65
8	stop → approximant	examine	[ɪɣ'zamɪn]	68
9	stop → approximant	I need everything	[aɪnið̲'ɛvrɪθiŋ]	92
10	elision	that belongs	[ð̲əbɪ'lɒŋz]	93
11	stop → approximant elision	Couldn't we	['kʊ̯ð̲n̲wɪ]	96
12	stop → approximant elision	find amongst some	['faɪn̲ð̲əmʌŋs's m]	97,98
13	stop → approximant	beloved	[bɪ'lʌvɪð̲]	100
14	elision	pounds	['paʊ̯n̲z]	105
15	stop → approximant	could afford	[kə̯ð̲ə'fɔd]	108
16	stop → approximant voiceless → voiced (2)	and what about you	[n'wɒð̲əbaʊ̯ð̲'ju]	113,114
17	elision	asked an	['ɑs̲tə̯n]	120
18	elision	kept quiet	[kɛp̲'k̲waɪə̯t]	123
19	stop → approximant	in order to	[ɪn'ɔð̲ətə]	138
20	stop → approximant	greeted with	['grit̲ɪð̲wɪð]	151
21	stop → approximant	able to	['eɪβ̲ltə]	164
22	elision glottalization	hold back	['hoʊ̯l̲bɑʔ]	165
23	stop → approximant	which had	[wɪt̲ʃə̯ð̲]	168
24	stop → approximant voiceless → voiced (2)	interrupted	[ɪntə'rʌβ̲tɪð̲]	176
25	stop → (2) approximant	hadn't been	['hað̲n̥β̲ɪn]	187

English (continued)

26	stop → approximant	ending	[ɛnə̲ɪŋ̟]	188
27	stop → (2) approximant	not a single	[nɒð̲ə'sɪŋɣ̟l̟]	191

French

1	stop → approximant	example de	[ɛg'zɑ$^{(m)}$plə̲ð̲ə]	11
2	stop → approximant	lézard dans la	[le'zaR̲ð̲ɑ̃la]	16
3	stop → approximant	abandonne	[abɑ̃ð̲ɔn]	17
4	stop → approximant	tant de mamelles	['tɑ̃ð̲ə̲ma'mɛl]	44
5	stop → approximant	rien de trop	['Rjɛ̃ð̲ə'tʀ̥o]	73
6	addition	trouverions	['tRuvɛRi̲jõ]	78
7	stop → approximant	certains d'entre	[sɛR'tɛ̃ð̲ɑ̃tRᵊ]	80
8	stop → approximant	indispensables	[ɛ̃ð̲ispɑ̃'sab̥l̥]	88
9	voiceless → voiced, stop → approximant	grosse? dit brusquement	['gRozdi̲βRyskə̲'mɑ̃]	92, 93
10	stop → approximant	chacun de vous	[ʃakœ̃ ð̲ə'vu]	103
11	stop → approximant	esprit de	[ɛs'pRi̲ð̲ə̲]	109
12	stop → approximant	disposition de	[dispozi'sjõð̲ə̲]	112
13	stop → approximant	lion déconfit	['ljõð̲ekõ̞fi]	128
14	stop → approximant	son discours	[sõ̞ð̲is'kuR]	140
15	stop → approximant	pendant les vingt	[pɑ̃ð̲ɑ̃le'vɛ̃]	154

Spanish

1	stop → approximant	todo el mundo	[toðel'mun̲ð̲o]	7
2	stop → approximant	sangre	['saŋɣre]	17
3	stop → approximant	cuando	['kwanð̲o]	21
4	elision	muchos de	['mutʃo̲ðe]	32
5	stop → approximant	un vital	[umβi'tal]	42
6	stop → approximant	tan grande	[taŋ'ɣ̟rande]	50
7	stop → approximant voiceless → voiced	absolutamente	[aβso'luta'men̲ð̲e]	73

Spanish (continued)

8	tap → fricative	tranquila	[tɹaŋ'kila]	74
9	stop → approximant voiceless → voiced	lo que tengo	[loɣe'teŋgo]	94
10	stop → approximant voiceless → voiced	porqué	[porᵊ'ɣe]	113
11	voiceless → voiced	cabeza tan	[ka'βeθa̲da̲ŋ]	116
12	stop → (2) approximant	tan grande	[da̲ŋ'ɣra̲n̲δe]	116
13	stop → approximant	disposición de	[δ isposi'θjon̲δe]	142
14	stop → approximant	tenga	['teŋɣa]	129
15	stop → approximant	grandes	['gᵊra̲n̲δes]	144
16	stop → approximant	empezando	[empe'θan̲δo]	146
17	stop → approximant	leon desconcertado	[le'on̲δeskonθer'taδo]	155
18	stop → approximant	con dificultad	[kon̲δificul'taδ]	161

The types of consonant modification in the texts analyzed show some similarities. The vast majority of the segments concerned are voiced alveolar or dental stops, realized as approximants (or without complete closure). In French, the only examples not of this type are 6 and 9. English shows slightly more variation in that examples 2, 5, 8, 17, 22 and 27 involve velar articulations and 21, 24 and 25, labial. In Spanish, numbers 2, 6, 9, 10, 12 and 13 concern velar articulations and the rest alveolar/dental.

The differences however, are more striking. As English has a great many more closed syllables than French, the majority of cases of consonant modification occur on arresting consonants or clusters. Only seven involve releasing consonants, numbers 3, 11, 19, 21, 25, 26 and 27 and none of these are of stressed syllables. Of the arresting

consonants, many are elided, in numbers 1, 3, 4, 6, 10, 11, 12, 14, 17, 18 and 22, but they are members of arresting clusters formed by two or three segments. Where there is only one arresting consonant which has been elided, it belongs to a short function word such as 'what' or 'that'. This shows a preference to avoid long clusters, if they are in syllable-final position, and to use consonant elision possibly as a means of crushing syllables together. The above observations also support the hypothesis of syllable-initial consonant tension in English, particularly on stressed syllables.

In French and Spanish on the other hand, almost all consonant modification takes place on releasing consonants. This is not surprising; with the preponderance of CV structures in Spanish and French, almost any modification has to be on releasing consonants, particularly in Spanish which has a very small system of arresting consonants, realized as fricatives or approximants anyway with the exception of [l], [r] and nasals. All the French examples are syllable-initial except N° 9 [z] and although they seem to occur mainly on function words, there are two examples concerning stressed syllable-initial consonants in content words, N°s 3 and 9 [β]. Almost all the Spanish examples are of the same type, /d/ /g/ or /b/ preceeded by a nasal and realized as an approximant. The allophonic realization of these phonemes in all studies of Spanish is considered to be a stop. In the text analyzed there were in fact very few instances of voiced stops, realized as stops, after nasals. The only clear occurrences of voiced stops with complete closure were in utterance-initial position. A complete revision of Spanish allophones and more data would be necessary to establish this as common practice but some researchers working on Spanish have also observed it. Of the Spanish examples, three were initial of stressed syllables, N°s 6, 10

and 11 where /k/ is voiced and therefore realized as a voiced approximant in this environment. All examples were in syllable-initial position.

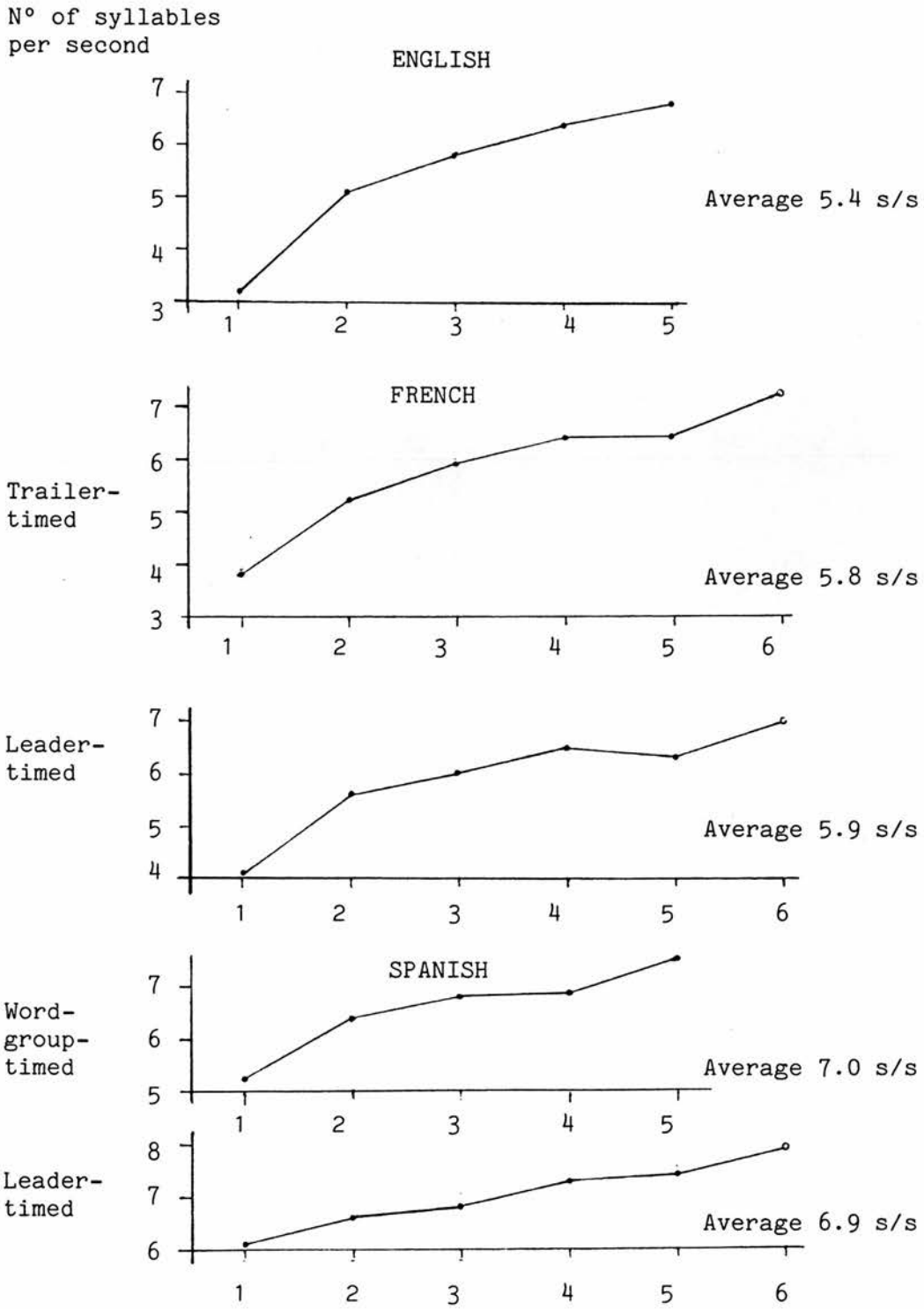
French and Spanish are alike in that modification of syllable-initial consonants can take place, especially on unstressed syllables. Spanish consonants of course undergo greater modification in syllable-final position and intervocalically, which is treated in the phonemic analysis of Spanish (Chapter II). English however, exhibits little consonant modification in syllable initial position, compared to final, and it occurs particularly in clusters and when the consonant is final of a short function word. In all three languages, the most unstable consonant elements are voiced (and voiceless to a lesser extent) alveolar/dental stops.

3.1.4 Rate of Syllable Succession

In the performance of any motor task, the preferred limits of intervals between acts are from 0.2-1.0 sec. on average (Woodrow, 1951 in Allen, 1975 : 78). The rate of syllable succession in the languages examined is slightly faster than this (Figure 36, Table 39) on average for syllables of internal stress groups, English 5.4 syl/sec., French 5.8 syl/sec., and Spanish 7.0 syl/sec. These results coincide with similar studies, English 5.9 and 5.0 syl/sec. (Dauer, 1980 : 347), English 5.3 syl/sec. (Patch, 1974), English 4.6 syl/sec. (Uldall, 1971 :206-7); French 5.7 syl/sec. (Malecot et al., 1972, in Dauer, 1980: 329); Spanish 7.2 syl/sec. (Pointon, 1978 : 63-67). (The difference of 0.1 in the two analyses of French and Spanish is due to the inclusion of post-pausal groups in the trailer- and word-group-timing analyses of French and Spanish respectively.) Allen states that for languages with syllable-based rhythms, the rate of syllable succession is quicker, from an average of 0.1 seconds/mora in Japanese to about

Figure 36

English, French and Spanish : Noah's Ark
Graphs of average rate of syllable succession according to stress group type. 2 analyses for French and Spanish.



o Average based on 2 or 3 stress groups

TABLE 39

English, French and Spanish : Noah's Ark
Average rate of syllable succession according to stress group type in syllables per second. 2 analyses for French and Spanish

	Number of syllables per stress group						Average rate of total N°
	1	2	3	4	5	6	
English	3.2	5.1	5.8	6.4	6.8		5.4
French (Trailer-timing)	3.9	5.2	6.0	6.4	6.4	(7.3)	5.8
French (Leader-timing)	4.1	5.6	6.0	6.5	6.3	(7.0)	5.9
Spanish (Word-group-timing)	5.25	6.4	6.8	6.8	7.5		7.0
Spanish (Leader-timing	6.1	6.6	6.8	7.3	7.4	(7.9)	6.9

0.2 seconds per syllable in French (Allen, 1975 : 80). From Table 39 and other studies mentioned, there is not very much difference between average rates in English and French (5.4 syl/sec. = 0.19 sec/syl and 5.8 syl/sec = 0.17 sec/syl). The rate in Spanish is considerably quicker on average than in English and French (7.0 syl/sec = 0.14 sec/syl). In the three languages examined, the rate increases as the number of syllables per stress group increases. Between one and five-syllable stress groups, the rate more than doubles in English from 3.2 to 6.8 syl/sec., increases by 61% in French from 3.9 to 6.4 syl/sec. and only by 43% in Spanish, from 5.25 to 7.5 syl/sec. In all languages, the main increase in syllable rate is produced between one and two-syllable stress groups. The increase between two, three and four-syllable groups which are the commonest types, is almost identical in English and French, a difference of 1.3 syls between two and four syllable groups in the case of English and 1.2 syls in French. The increase in Spanish is much less, only 0.4 syls, showing that the rate is not only much quicker in Spanish but also more constant in these common stress group types. In the French and Spanish leader-timing analyses, there is less increase in the rate of syllable

succession, but the difference is mainly between one and two-syllable groups. This is again indicative of the appropriateness of trailer-timing and word-group-timing for French and Spanish. The number of syllables averaged is important; the three types of stress groups in Spanish which have very similar rates of syllable succession contain 297 syllables, 87% of the total number used in this test, and there were only eight one-syllable groups. The proportions are similar in English and French. In English two to four-syllable groups make up 89% of the total number of syllables used and in French 83% but as the rate of succession increases by so much more in English and French than in Spanish (see above), this is indicative of stress-timing tendency in English and French and syllable-timing tendency in Spanish.

Stress-timed rhythms, according to Allen (1975 : 79) are rhythms of alternation, as in English, where stressed syllables alternate with all of the intervening unstressed syllables, and syllable rhythms are those of succession. The latter would seem to be at variance with the preferred limits within which motor tasks are performed (0.2-1.0 secs), as in Spanish, the average rate of syllable succession is 7 syllables per second, i.e. 1 syllable per 0.14 sec. In Spanish there seems to be an alternating rhythm within the stress group of one perceptually prominent syllable (which may be the stressed syllable) followed or preceded by one or two less prominent syllables, according to how many syllables the group contains. To quote some examples from the data: in stress groups N°s 37, 38 ['ser$^{\partial}$ sakrifi'kaδos], [ser] and [ka] are definitely stressed but the syllable [kri] sounds more prominent "mas fuerte" to a native speaker of Spanish than the other unstressed syllables thereby producing an alternating rhythm. In stress group N° 139 however, the same syllable is less prominent

because it is adjacent to the following stressed [es'pirituððsakri'fi-θjo]. In this case, [tu] and [sa] are more prominent than the other unstressed syllables. In syllables of the same phonematic structure, there does seem to be a durational correspondence. In the first example, [kri] (138 ms) is longer than [sa] (123 ms), but in the second, [sa] (140 ms) is longer than [kri] (105 ms). The combined durations of the pairs is very similar, 261 ms in the first example and 245 ms in the second. The longest stress group in the Spanish data, N° 137 contains eight syllables [peroparaðemos'traroz]. Of the six unstressed syllables preceding the stressed, [pe], [pa] and [ðe] are more prominent than the others, forming three groups of two. Again they are longer than the others, except for [mos] which is long due to its structure. Apart from duration, there is no instrumental evidence of there being any difference between prominent and less prominent unstressed syllables within the stress group. There is certainly no phonological reason why unstressed syllables should be differentiated phonetically.

Certain words in Spanish change their stress patterns according to their phonetic environment, e.g. "señor" uttered in isolation is stressed on the second syllable and also when it is followed by a name whose first syllable is unstressed, e.g. "Señor Rodriguez", but when the name following it is stressed on the first, the stress on "señor" moves to the first syllable also, e.g. "Señor Perez". The name "José" is stressed on the second syllable when uttered alone, the stress is probably neutralized in a short compound name such as "José Luis", but in a long compound name, the stress definitely moves to the first syllable "José Antonio". Allen also gives an example of a stress shift on the word "hasta" from the first syllable in "Fui hasta Méjico" to the second in "Fui hasta Monterrey", giving as his reason

the unstressed syllables of "Monterrey" that immediately follow "hasta" (Allen, 1968c : 68. Example furnished by Prof. José Cruz-Salvadores and Sr. Rosario Gringas). This example is rather dubious for the following reasons: in "Fui hasta Méjico", "fui" is stressed (there are very few adjacent stressed syllables in Spanish) and is only followed by two syllables before "Méjico", a perfectly normal grouping in Spanish, so neither is stressed, and in "Fui hasta Monterrey", "fui" and "-rrey" are the stressed syllables, but of the unstressed, "Mon" is the most prominent perceptually, thus two groups are formed in the second stress group, each of alternating rhythm "hasta Monterrey". If syllables in Spanish can be said to form groups of alternating rhythm, composed of one stressed syllable and one or two unstressed, or one prominent (unstressed syllable) and one or two unstressed, these would occur at the rate of between 2 and 3.5 groups per second which would then fit into the preferred range of 0.2-1.0 seconds for motor tasks. The average rate of recurrence of stress groups also fits into this range (Section 3.2.1). Navarro Tomás noticed a rhythmic alternation within unstressed syllables. This is referred to in Chapter II but is quoted again here for convenience:

> "No conocemos suficientemente la naturaleza del acento rítmico, ni los principios por que éste se rige en la lengua española; sin embargo, en series silábicas de cierta extensión, el oido, por lo que al acento se refiere, cree percibir un movimiento alternativo de aumento y disminución, en vitud del cual, las sílabas débiles, a partir de la sílaba fuerte de cada grupo, se distinguen entre sí, destacandose u oscureciendose sucesivamente".
> (We don't know enough about the nature of the rhythmic beat nor about the principles which govern it in the Spanish language; however in syllable groups of a certain length, the ear, as far as the beat is concerned, percives an alternating movement of increase and decrease, due to which the weak syllables following the strong syllable of each group, are distinguished among themselves, by being salient or obscured successively.)
> (Navarro Tomás, 1963 : 195).

He gives as examples words such as "panadero, marinero, cariñoso" which have the stress on the penultimate syllable but the first

syllable in each case is heard as more prominent than the other unstressed syllables.

The rate of syllable succession in French is also quicker than 0.2 secs/syl. Although French has no phonological word accent, there are many syllables that can never be stressed in French, others, word-final, which are normally stressed (den Os, 1983 : 19) and others which are potentially stressable. In the text analyzed, syllables which were never stressed were those of small function words such as "de, le la, il, elle, un, une" and "-tre, -ple" forming an extra syllable in words such as "notre", "d'entre" "exemples", those normally stressed were utterance and tone group final but some others were emphasized and perceived as stressed. It is possible that there is a similar alternating rhythm in French unstressed syllables as in Spanish, at least the unstressable syllables are less prominent than those with potential stress. In stress group N° 32 [õɛ̃tɛRɛvi'tal], the syllable [ɛ̃] and [Rɛ] are heard as more prominent than the others and similarly in N° 111 [zaladispozi'sjo], [dis] is more prominent. This is not so obvious as in Spanish however, and there is no instrumental evidence which differentiates these syllables. It is possibly the result of a necessity to impose a rhythm on a long stretch of undifferentiated syllables. Both of the above examples are very long groups, 770 ms and 735 ms respectively.

Undoubtedly there are various interacting rhythmic patterns present in any language at the phonetic level, the bases of these being the ordering of syllables. In Spanish syllables succeed each other at a fast rate, 7.0 syllable/second (or 0.14 seconds/syllable) so there may be a tendency for syllables to fall together in rhythmic groups which need not necessarily contain a stressed syllable. There is certain

evidence of this at the perceptual and instrumental level. The rhythm of Spanish prose would therefore not be merely one of succession but of alternation, stressed syllables alternating with unstressed and unstressed-prominent syllables alternating with unstressed in very long stress groups.

3.2 The Stress Group

3.2.1 Interstress Intervals

3.2.1.a,b,c. Relationship between interstress intervals and syllables per stress group.

In a strictly stress-timed language, the number of unstressed syllables between stressed should have no influence on the duration of the group which remains constant, and in a syllable-timed language, the duration of the stress-group should vary in proportion to the number of syllables contained in it. None of the languages examined conform to either pattern but certain tendencies emerge from the data. Figure 37 and Table 40 show average durations and standard deviations of internal stress groups (including post-pausal for French and Spanish) according to the number of syllables per stress group.

In English and French, although stress group average durations do increase with the number of syllables per group, there is considerable overlap between the standard deviations of one stress group type and the next of all types in English and particularly of two, three and four-syllable types in French. One and five-syllable types do not overlap to such an extent in French but the other types have remarkably similar average durations and standard deviations. What is more, two to four-syllable groups are the commonest; in English they account for 89% of the total, in French 83% and in Spanish 87%. On the other hand, in Spanish the durations covered by the average plus

Figure 37

English, French and Spanish : Noah's Ark
Average stress group durations and standard deviations according to number of syllables per stress group

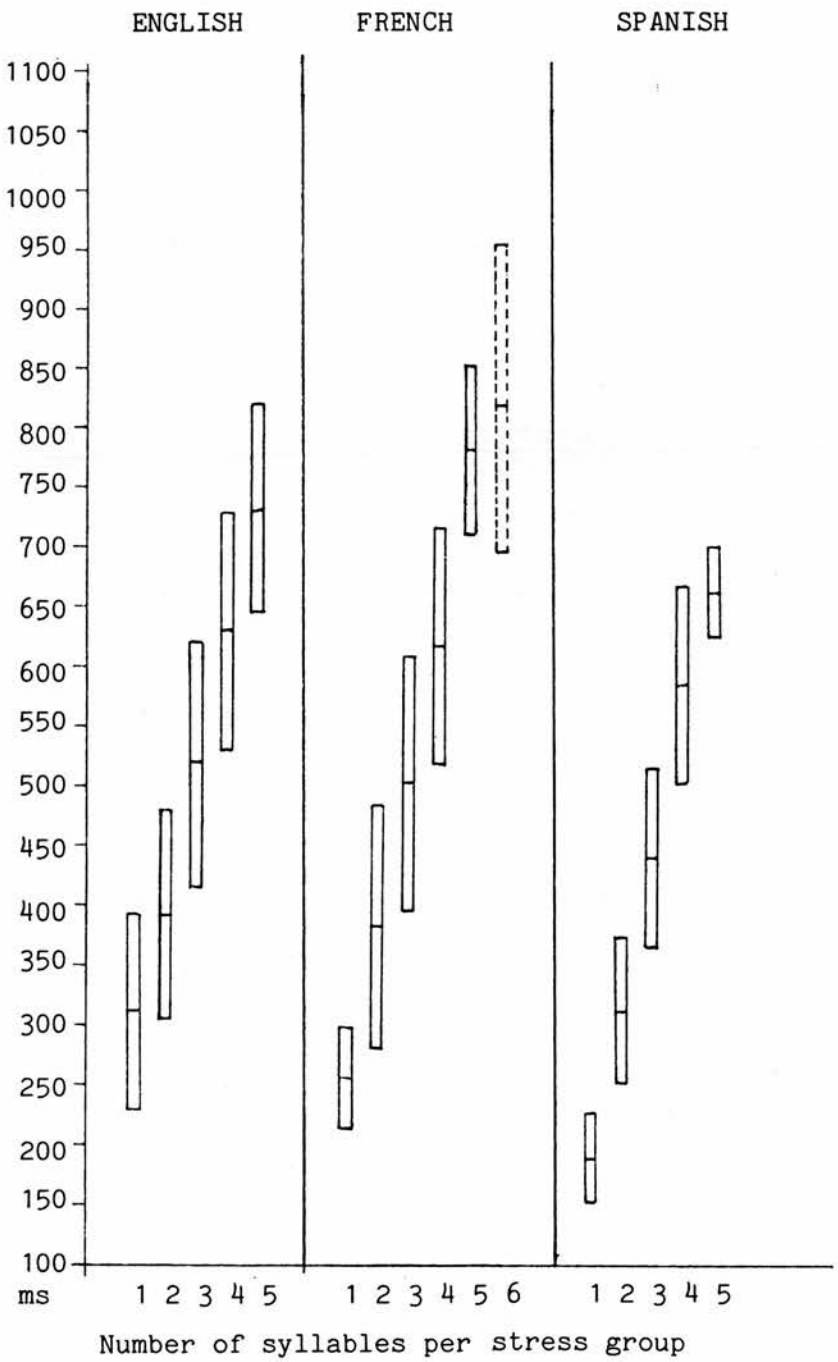


TABLE 40

English, French and Spanish : Noah's Ark
Average durations and standard deviations of internal stress groups according to the number of syllables per group.

	English			French			Spanish		
S/SG	AD	SD	N	AD	SD	N	AD	SD	N
1	312	81	9	257	43	11	190	38	8
2	394	89	34	383	101	38	313	61	45
3	517	102	46	503	108	25	441	76	37
4	628	100	11	618	99	22	585	83	24
5	732	88	4	782	70	5	663	39	8
6				827	129	2			

S/SG = Syllables per stress group
AD = Average duration in ms (rounded off)
SD = Standard Deviation
N = Number.

and minus one standard deviation hardly coincide at all, except between four and five-syllable groups. The two-syllable groups do not double the duration of one-syllable groups but if the average duration of the syllables of a two-syllable group is added to the average duration of the whole group once and then again, the resulting durations are very similar to the actual average durations for three and four-syllable groups in Spanish. This is not the case in French and English. The following table will help to clarify this point. Expected durations are those that would result if stress group durations increased proportionately to the addition of average syllable duration of two-syllable groups.

TABLE 41

Actual and expected stress group durations of three and four-syllable groups in milliseconds.

	English	French	Spanish
A. Actual average duration of 2-syllable S.G.	394	383	313
B. A halved, giving average syllable duration	197	191.5	156.5
C A + B Expected average duration of 3-syllable S.G.	591	574.5	469.5
D. Actual duration of 3-syllable stress groups	517	503	441
E. Difference between C and D	74	71.5	28.5
F. C + B Expected average duration of 4-syl S.G.	788	766	626
G. Actual duration of 4-syllable stress groups	628	618	585
H. Difference between F and G	160	148	41

S.G. = stress group; syl = syllable.

In the above table, the difference between C and D is almost the same in English and French and much less in Spanish, similarly the difference between F and G. This indicates that in Spanish the increase in average duration between two and four-syllable stress groups is almost proportional to the syllable added in each case, whereas in English and French, four-syllable groups fall far short of the expected average duration, which should of course double that of two-syllable groups in objective syllable-timing. It can hardly be said that French is a syllable-timed language according to these results. It behaves in a way very similar to English across the commonest stress group types. Admittedly the one and five-syllable groups behave differently and give the impression of separating out the different group types more so in French than in English (Figure 37) but it must be remembered that there are very few of these group types in all the languages examined, 13 in English out of a total of

102, 18 in French (including the two six-syllable groups) out of 103 and 16 in Spanish out of 122. Referring back to Table 28,p.190 which includes the ratios between the different stress group types, stress group duration in Spanish is not too far short of being proportional to the number of syllables per group between one and five-syllable groups 1:3.48 (word-group-timing), French less so 1:3.04 (trailer-timing) and in English the ratio is smaller again 1:2.35. There is some indication therefore of syllable compression according to the number of syllables per stress group in Spanish, although very little compared to English, and French again lies in between.

In all stress group types there was more variation in English and French than in Spanish (Table 40). In one-syllable groups, the difference was significant between English and French $F = 3.53$, $p < .05$, and between English and Spanish, $F = 4.56$, $p < .05$, but not between French and Spanish. However, the commonest stress group types followed the same pattern: for two-syllable groups variation in French was greater than Spanish, $F = 2.76$, $p < .01$, and in English greater than Spanish, $F = 2.13$, $p < .01$, the difference between French and English not being significant. Similarly in three-syllable groups, the variation in French was greater than Spanish, $F = 1.98$, $p < .05$, and English greater than Spanish, $F = 1.77$, $p < .05$, but again no significant difference between English and French. In four-syllable groups, English and French have very similar standard deviations, both greater than Spanish, but the difference in variation is not significant. In five-syllable groups, the variation in Spanish is again small but only English shows a significant difference, $F = 5.13$, $p < .05$.

TABLE 42

English, French and Spanish : Noah's Ark and others
Central tendencies of internal stress groups
(including post-pausal, French and Spanish)

	75% of stress groups between	range	Average Duration	Standard Deviation	Variation Coefficient
English					
Noah's Ark	322 - 637	315	481	137	28.5%
Dauer[1]	300 - 580	280	450	131	29%
Dauer[1]	300 - 640	340	480	142	29.5%
Uldall[2]	390 - 705	315	530	147	28%
French					
Noah's Ark	261 - 704	443	472	172	36.5%
Spanish					
Noah's Ark	252 - 607	355	423	150	35.5%
	320 - 690	370	520	177	34%

1. Dauer, 1980 : 345
2. Uldall, 1971 : 206-207.

TABLE 43

English, French and Spanish : Noah's Ark
Central tendencies of all internal syllables

	75% of syllables between	range	Average Duration	Standard Deviation	Variation Coefficient
English	93 - 274	181	176	79	45%
French	97 - 235	138	161	60	39%
Spanish	96 - 199	103	145	44.5	31%

When all stress groups are examined however (Table 42, Figure 38), the central tendencies of the three languages are very similar as far as range and average durations are concerned. The majority of the groups (75%) lie within relatively narrow ranges, English 315 ms, French 443 ms and Spanish 355 ms in the texts analyzed. Average durations of stress groups all lay between 400 and 500 ms. Results from similar studies are included in Table 42. F tests for variance were applied and the following results emerged (Table 44):

TABLE 44

English, French and Spanish: Noah's Ark
F tests for variance in syllable and stress group duration

Syllable Variation

English > French ($F = 1.72$, $p < .01$)
French > Spanish ($F = 1.82$, $p < .01$)
English > Spanish ($F = 3.13$, $p < .01$)

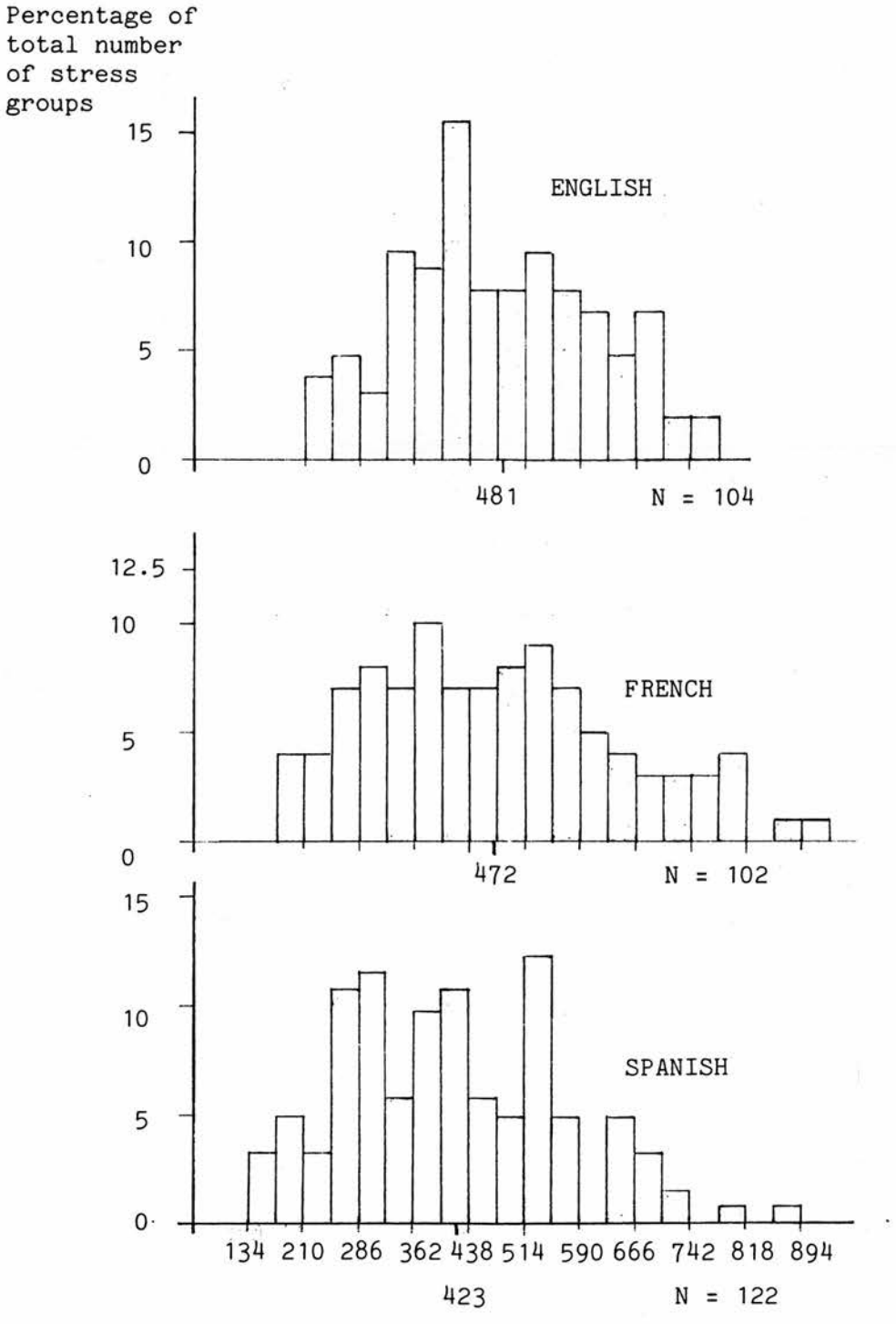
Stress Group Variation

French > Spanish (Not significant)
Spanish > English (Not significant)
French > English ($F = 1.57$, $p < .05$)

Variation in syllable duration which has already been discussed (Section 3.1.1.a) is included in order to make comparison easier (Table 18, 19). English has greatest variation of the three languages at the level of syllable and least at the stress group level, however, the difference in syllable variation is significant but stress group variation is only significant between French and English and at a higher level of probability. French syllable variation is also significantly greater than Spanish, but stress group variation is almost the same. Although variation in Spanish stress groups is greater than English, the difference is not significant. Comparing Figures 38 and 39 (included here for convenience), these differences become apparent. Between the two histograms for English there is no

Figure 38

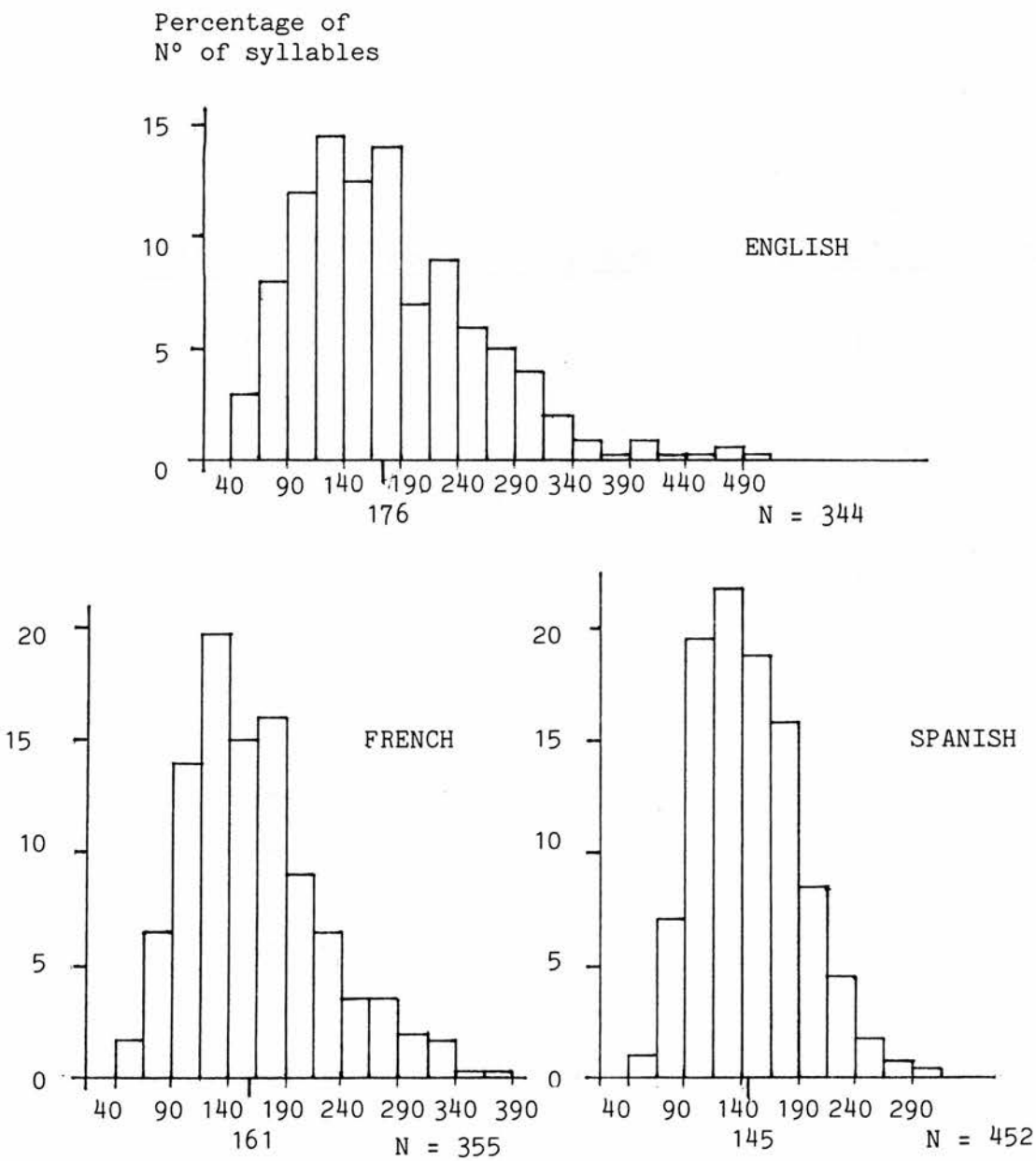
English, French and Spanish : Noah's Ark
Histograms of stress group duration as percentage of total number of internal groups.



Duration in ms showing averages.

Figure 39

English, French and Spanish : Noah's Ark
Histograms of syllable duration as percentage of all syllables of utterance internal stress groups.



Duration in ms showing averages.

obvious change but in the histograms for French and Spanish, there is a much more even distribution over the range of values for stress groups than syllables.

In Table 42, variation coefficients ($\frac{SD}{\bar{x}}$ x 100) are given to compare syllables and stress groups as F tests were not suitable. The figures for English stress groups are all very much the same, but those for French and Spanish are considerably higher. English syllables show more variation than English stress groups, French slightly more, syllables > stress groups and Spanish less, syllables < stress groups. This is what one would expect and it tallies with previous results.

The BMDP(P2V) analysis was repeated with language and stress groups as variables and it was found that in Spanish stress groups were significantly shorter than both English and French (which do not differ significantly). This is again a reflection of the shorter stressed syllables in Spanish as there was very little difference in average durations of unstressed syllables among languages and the average number of syllables per group was similar in all three (English 2.6, French 2.9, Spanish 2.9). The comparatively quick speech rate of the Spanish informant may also have influenced the results.

The tendencies that the languages exhibit according to the results of this section may be summarised as follows:

<u>English</u>

According to stress group type:

a) Greater variation than Spanish (p.246, Table 40, Figure 37) (Significant)
b) Smaller gap between average stress group durations than Spanish. (Table 40, Figure 37, Table 41).

	c) Stress groups do not increase in proportion to added syllables. (Table 41).
All internal stress groups:	a) Less variation than French (significant) and Spanish (not significant). (Table 44). b) Longer than Spanish (p. 251). (Significant).

French

According to stress group type:	a) Greater variation than Spanish, except one-syllable groups. (p. 246, Figure 37, Table 40). (Significant). b) Smaller gap between average stress group durations than Spanish (2-4 syllable groups). (Table 40, Figure 37, Table 41). c) Stress groups do not increase in proportion to added syllables. (Table 41).
All internal stress groups: (and post pausal)	a) More variation than English (significant) and Spanish (not significant). (Table 44). b) Longer than Spanish (p. 251) (Significant).

Spanish

According to stress group type:	a) Less variation than English and French (p. 246, Figure 37, Table 40). b) Greater gap between average stress group durations than English and French (2-4 syllable groups). (Tables 40, 41, Figure 37). c) Stress groups increase in proportion to added syllables, 2-4 syllable groups (Table 41).
All internal stress groups: (and post-pausal)	a) Less variation than French and more than English (not significant). (Table 44). b) Shorter than English and French.

Although Spanish stress groups are significantly shorter than those of English and French, the difference is small and not above the JND's for these figures, 49 ms between Spanish and French and 58 ms between Spanish and English. The mean absolute difference limen for a reference duration of 480 ms is 68.64 ms (Henry, 1948 in Lehiste, 1970 :

12). In Dauer's results Spanish stress groups were longer than English but again only by 70 and 40 ms (Table 42). The evidence all indicates that more important durational differences are present in the interaction of language and syllable (Section 3.1) than in that of language and stress group. Average durations and preferred stress group durations (Table 42, Figure 38) are very similar. Preferred stress group types are also the same in the three languages. Two, three and four-syllable groups account for the vast majority in each case (Section 3.2.2). Dauer suggests from similarities in preferred interstress intervals between Greek, English and Spanish, that we are possibly faced with a language universal:

> "The close correspondence between the rate of succession of stressed syllables in the languages investigated and general tendencies in motor behaviour clearly show the importance of stress in speech production. We may say all these languages (and perhaps all languages with 'stress') are stress-based, and that stresses normally recur within a limited range of time intervals...in production which corresponds to a similar range in perception (according to Woodrow, 1951 : 1225, "the greatest accuracy for discrimination and reproduction lies within the range extending from 0.2 to 2.0 seconds"). Since stress usually occurs at a certain point in each important word in the sentence, this regularity must help us to process information at our optimal rate and to anticipate the location of the next information unit (as suggested by Martin, 1972 : 503, 506)." (Dauer, 1980 : 346).

Although French has no word accent (which is presumably what is meant by languages with "stress") like Spanish, English and Greek, the same can be said to apply, as the majority of stressed syllables in French are in tone group and utterance final position, recurring within a limited range of time intervals and may therefore serve as boundary markers for information units (Leon & Leon, 1971 : 64-66). (See also Chapter I.)

3.2.2 Frequency of occurrence of stress groups

It has already been mentioned that the three languages in this study coincide in their preferred stress group types. Percentages of groups according to the number of syllables they contain are shown in Figure 40 and actual numbers and percentages in Table 45. The histograms for French and Spanish are very similar: two, three and four-syllable groups (in that order) are the commonest types for both internal groups and internal and pre-pausal. In French, these account for 82% of internal groups and 81% of all groups and in Spanish 86.5% and 85%. There are more four and five-syllable groups than in English and although the groups may occasionally be longer, there are comparatively few six, seven and eight syllable groups. However, the group types are more evenly distributed than in English. Two, three and four-syllable groups are also the preferred types in internal groups in English but in the order three > two > four. Three-syllable groups make up the highest percentage (44.2%) and this may account for the higher concentration of stress group durations around the mean as shown in Figure 38. There is quite a remarkable difference between internal stress group distribution and all groups in English when compared to the other two languages. One-syllable groups increase by almost 14%, and there is a decrease in three-syllable groups. This is no doubt an artefact of the leader-timed analysis for English. Although Delattre (1965 : 29-30) found that English words were more likely to be stressed on the first or second syllable (in the case of four-syllable words), Hyman (1977 : 67) includes English among the languages for which he was not able to ascertain any dominant stress placement. The internal stress group distribution is therefore more reliable for English.

Figure 40

English, French and Spanish : Noah's Ark
Frequency of occurrence of stress group types

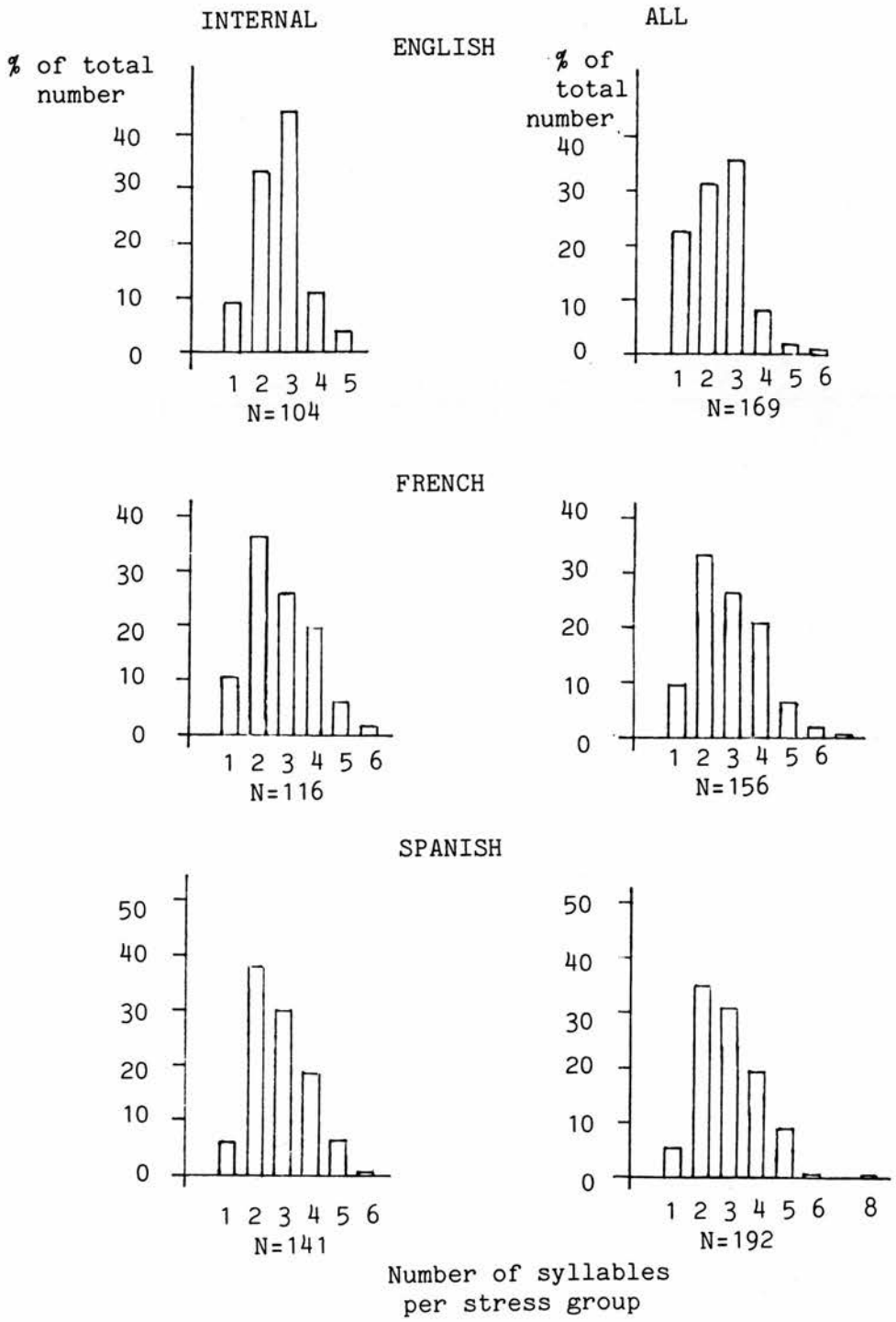


TABLE 45

English, French and Spanish : Noah's Ark
Frequency of occurrence of stress group types

English[1]

	Internal groups		Internal and Pre-pausal	
N° syllables per group	N	%	N	%
1	9	8.7	38	22.5
2	34	32.7	53	31.4
3	46	44.2	60	35.5
4	11	10.6	13	7.7
5	4	3.8	4	2.4
6			1	0.6

French[1]

1	12	10.3	15	9.6
2	42	36.2	52	33.3
3	30	25.9	41	26.3
4	23	19.8	33	21.2
5	7	6.0	11	7.0
6	2	1.7	3	2.0
7			1	0.6

Spanish[1]

1	9	6.4	10	5.2
2	54	38.3	67	34.9
3	42	29.8	59	30.7
4	26	18.4	37	19.3
5	9	6.4	17	8.9
6	1	0.7	1	0.5
8			1	0.5

1. English stress groups do not include post-pausal unstressed syllables occurring before first post-pausal stressed. French and Spanish internal groups include post-pausal groups.

3.2.3 Pre-pausal lengthening

In a recent article, Hoequist suggests that pre-pausal lengthening may be one of the acoustic signals which has an effect on the perception of the timing of languages (Hoequist, 1983a : 20). A syllable-timed language would presumably have less pre-pausal lengthening than a stress-timed language if there is an attempt on the part of the speaker to equalize units. Considering all syllables, Spanish would appear to have the least pre-pausal lengthening (Table 46). The ratios of internal syllables to pre-pausal are as follows: English 1:2 (176 ms internal, 350 ms pre-pausal), French 1:1.8 (161 ms internal, 284 ms pre-pausal) and Spanish 1:1.6 (145 ms internal, 231 ms pre-pausal).

TABLE 46

English, French and Spanish : Noah's Ark
Pre-pausal lengthening of syllables and stress groups

		English		French		Spanish	
		I	P.P.	I	P.P.	I	P.P.
All syllables	N	344	40	355	42	452	47
	AD	176	350	161	284	145	231
Stressed syllables	N	121	28	106	37	162	9
	AD	240	378	221	294	168	291
Unstressed syllables	N	223	12	249	3	290	38
	AD	143	283	137	174	132	217
Stress Groups	N	104	40	103	42	122	47
	AD	481	436	472	610	423	546

I = Internal; P.P. = Pre-pausal;
N = number; AD = Average duration in ms.

Hoequist, in an experiment comparing syllable lengthening in Japanese and Spanish found that the ratio of non-final to final syllables was 1:1.3 (Hoequist, 1983a : 28). His informants however were from unspecified places in South America and I have noticed that in

Venezuela and particularly Argentina, stressed syllables in connected speech seem to be longer than corresponding syllables in Castillian Spanish. If non-final stressed syllables are longer, the ratio of non-final to final would be reduced, assuming that the duration of the final syllable remains approximately the same. In both studies however, the duration of syllables in Spanish is increased more by the effect of occurring in pre-pausal position than by stress. The ratio of unstressed to stressed syllables in the text examined was 1:1.2. In English and French, pre-pausal lengthening also has a greater effect than lengthening due to stress, but in French, the difference is very small, unstressed to stressed syllable ratio = 1:1.7, internal to pre-pausal = 1:1.8. However, absolute pre-pausal lengthening remains constant in English considering stressed and unstressed syllables separately, and the ratio changes, whereas the opposite happens in French and Spanish. The ratios are virtually the same but the actual increase differs:

			Ratio	Mean Difference of
English:	Stressed internal:	Stressed pre-pausal	1:1.6	138 ms
	Unstressed internal:	Unstressed pre-pausal	1:2	140 ms
French:	Stressed internal:	Stressed pre-pausal	1:1.3	73 ms
	Unstressed internal:	Unstressed pre-pausal	1:1.3	37 ms
Spanish:	Stressed internal:	Stressed pre-pausal	1:1.7	123 ms
	Unstressed internal:	Unstressed pre-pausal	1:1.6	85 ms.

In the French data there were only three examples of unstressed pre-pausal syllables and the apparent discrepancy between the ratios for stressed vs unstressed syllables and all syllables is of course, due to the fact that the majority of pre-pausal syllables in French are stressed (Table 46).

Considering the whole stress group, the ratios of internal to pre-pausal were as follows: English 1:0.9, French 1:1.3, Spanish 1:1.3. The result is misleading for English as the vast majority of pre-pausal groups contained only one or two syllables due to the leader-timed analysis. Comparing one-syllable internal groups to pre-pausal, the ratio was 1:1.23 and for two-syllable groups, 1:1.34, very similar in fact to the ratios for French and Spanish. There is a correspondence between these results and those in previous sections. Durational differences are not very apparent at the stress group level but begin to emerge at the level of syllable, particularly when stressed and unstressed syllables are considered separately (cf. Chapter IV on pre-pausal lengthening in Spanish).

3.2.4 Position of stressed syllables in the speech continuum

Ladefoged refers to "...a conspiracy in English to maintain a regular rhythm" and gives as evidence example sentences where stress falls on alternate words rather than each word, "The 'big brown 'bear ate 'ten white 'mice"; examples of unstressed accented syllables, "'Mary's younger 'brother wanted 'fifty chocolate 'peanuts"; and examples of the position of stress changing on some words, "He had a 'clarinet 'solo", "He plays the clari'net" (Ladefoged, 1975 : 102-3). The strongest evidence for this in the English text was in the absence of stress on potentially stressable mono-syllabic words in phrases such as "...'try to keep 'calm" (Stress groups 17, 18), "...'round like a 'curse" (Stress groups 49, 50), "'Why have 'you got 'such a big 'head?" (Stress groups 115-118). There were also several instances of disyllabic words which were unstressed: "getting", "about", "very", "amongst" and "throughout" (Stress groups 5, 76, 79, 97, 193 respectively). As French has no word accent, this could not be tested. In Spanish also, there were several instances of disyllabic unstressed

words: "todo el 'mundo", "nuestra", "para", "entre", "hasta", "pero" (Stress groups 7, 17, 25, 44, 137, 132, 98, 124, 125), but no unstressed content words. As the majority of content words in Spanish are composed of two or more syllables and there is a language-specific preference for words to be accented on the penultimate syllable, stresses are usually kept apart anyway. Instances of contiguous stressed syllables were few and approximately the same in all three languages: English, nine cases; French, eleven; and Spanish, eight (stressed syllables divided by pauses not included). First members of pairs of contiguous stressed syllables, which correspond to one-syllable stress groups in English were longer than the corresponding syllables of one-syllable groups in French and both longer than those in Spanish (Figure 37, Table 40). The preference for stressed syllables not to occur contiguously is not restricted to English, but maybe is manipulated more in English as there are fewer monosyllabic words in Spanish.

4. Summary of Results

The results of this comparison of the rhythmic characteristics of Spanish with those of French and English, are presented overleaf, in accordance with the tabulation in the Introduction.

Characteristics of syllable-timing	Characteristics of stress-timing
4.1 The Syllable	
4.1.1 Syllable Duration	
4.1.1.a Variation in syllable duration is significantly smaller than in English and French.	
4.1.1.b Average syllable duration varies very slightly according to the number of syllables per stress group.	Average duration of stressed syllables decreases between one and two-syllable groups (19 ms) and between two and three-syllable groups (13 ms).
4.1.1.c The duration of stressed vowels did not change according to the number of syllables per stress group.	
4.1.1.d The difference between stressed and unstressed syllable durations is significantly less than in English and French.	Stressed syllables are on average longer than unstressed.
4.1.2 Syllable Structure	
4.1.2.a The majority of syllables are of simple CV structure. Very few syllables contain 4 segments. Frequency of occurrence of syllable types is similar to that of French.	
4.1.2.b The distribution of syllable types in stressed and unstressed syllables is remarkably even compared to English and French where there is an obvious tendency for more complex syllables to be stressed.	
4.1.3 Segmental modification	
4.1.3.a Unstressed vowels undergo very little modification. They may be slightly more centralized than stressed vowels but their quality is always recognizable.	
4.1.3.b Consonants in both arresting and releasing positions are often modified or obscured, particularly those in the alveolar/dental region. Voiced consonants undergo more modification than voiceless.	

4.1.4 Rate of syllable succession

4.1.4.a Syllables tend to recur at approximately equal intervals. The increase in rate of syllable succession in rhythmic units containing more and more syllables is very slight.

4.1.4.b Average rate of syllable succession (7 syllables per second) is quicker than in English and French.

4.2 The Stress Group

4.2.1 Interstress intervals

4.2.1.a Interstress intervals vary considerably according to the number of syllables between stresses.

4.2.1.b Interstress intervals increase as the number of syllables per stress group increases. Between two and four-syllable groups, the increase is in proportion to the added syllables.

Average durations of one-syllable stress groups are long compared to the other stressed syllables.

4.2.1.c There is wider variation of interstress intervals than in English (not significant).

The majority of interstress intervals fall within approximately the same range as English and French.

4.2.2 Frequency of occurrence of stress groups

Stress group types are more evenly distributed than in English. Spanish permits long stress groups containing up to eight syllables.

The majority of stress groups contain two, three or four syllables in all the languages examined. Short and long stress groups are infrequent.

4.2.3 Pre-pausal lengthening

The ratio between pre-pausal syllables and non-final syllables is lower than in English.

The ratio between pre-pausal stress groups and non-final stress groups is approximately the same as in English.

4.2.4 Position of stressed syllable in speech continuum

The position of stresses did not vary in the text examined. There were no examples of unstressed content words therefore no tendency for stresses to occur on alternate words.

Very few stressed syllables occur contiguously.

5. Conclusion

According to the texts analyzed in this chapter, the phonetic features which emerge as differentiating the rhythm of Spanish prose from that of English and French involve various properties of the languages and it is obviously not sufficient to say that Spanish has a tendency towards syllabic isochrony when compared to English. Features which contribute to rhythmical differences are presented below. It must be borne in mind that these features only hold good for Spanish in relation to English and French. If we were comparing Spanish for example with a language which permitted only CV

Phonetic features contributing to rhythmical differences and similarities between English, French and Spanish.

	English	French	Spanish
Tendency towards isochronous syllables	-	-	+
Tendency towards isochronous stresses	+	-	-
Duration: important stress correlate	+	++	-
Leader-timed regulated stress groups	+	-	-
Trailer-timed regulated stress groups	-	+	-
Word-timed regulated stress groups	-	-	+
With phonological word accent	+	-	+
Fixed stress	-	++	+
Rhythm of succession	-	-	+
Rhythm of alternation	+	+	+
Consonant-reducing	-	+	++
Vowel-reducing	++	+	-
Weak vowel forms	+	-	-
Syllabic consonants	+	-	-
Peripheral vowels	+	+	+
Central vowels	+	+	-
Simple syllable structure	+	+	++
Complex syllable structure	+	-	-
Even distribution syllable structure stressed/unstressed	-	-	+

syllables, complex syllable structure would then be included as a feature of Spanish, as it does permit up to five segments per syllables word-medially (although rare and hardly ever realized as such). According to the table, there are only three phonetic

features which are common to all three languages: rhythm of alternation, peripheral vowels and simple syllable structure. These are possibly universal phonetic features. Spanish has more features in common with French than English but mainly of a negative nature: neither has a tendency towards isochronous stresses, they are not leader-timed, both have fixed stress, both are consonant-reducing (although French to a lesser extent than Spanish), neither has weak vowel forms or syllabic consonants or complex syllable structure. It may of course in fact be these negative features which have led English-speaking linguists to dub French as syllable-timed. Apart from the features mentioned above, Spanish has only two features in common with English: neither is trailer-timed and both have phonological word accent.

The features differentiating Spanish are the following: tendency towards isochronous syllables, duration is not an important stress correlate, word-timing, rhythm of succession (although it is suspected that an alternating rhythm may exist within series of unstressed syllables (Section 3.1.4)), not vowel-reducing, does not have central vowels and has an even distribution of syllable structure between stressed and unstressed syllables. Spanish has been attributed rhythms of alternation and succession. These are perfectly compatible. As the syllables succeed each other much more regularly in Spanish than in French and English, a rhythm of succession can be said to exist at this level (without making any claims for objective isochrony) but Spanish also has well-defined stressed syllables, the majority of which recur within quite a narrow range of time intervals and alternate with unstressed syllables, hence the feature of alternating rhythm. As an alternating rhythm may also occur within the unstressed syllables, the question is, which is dominant? These levels are investigated in the following chapter.

CHAPTER VI

TIMING EFFECTS IN SPANISH PROSE

1. Introduction

In the previous chapter, the phonetic features contributing to differences in the rhythms of English, French and Spanish prose were examined and summarized in a chart (p. 263). Those features which are attributed to Spanish have given rise to certain hypotheses concerning its rhythmic nature which are examined in this chapter under three main headings and in the light of data obtained from five native speakers of the language.

The main headings or categories which are applicable to any language (without necessarily excluding other possibilities), together with the phonetic features attributed to Spanish from the summary of results in Chapter V and the hypotheses which are to be tested, are listed below.

Suggested broad rhythmic categories applicable to any language

1. Word-group-timing, leader-timing or trailer-timing?

Features of Spanish:	Hypotheses:
Word-timed regulated	a) Any manipulation of syllable duration to achieve isochronicity between groups is controlled within the word-timed groups which are delimited by syntactic boundaries, rather than within interstress intervals.
	b) The duration of individual stressed and unstressed syllables within a group depends to a certain extent on the total number of syllables within that group.
	c) There are upper and lower preferred durational limits to the groups (depending on the speech tempo of the individual) and speakers attempt to bring extreme durations within these limits.

2. Syllable-timing or stress-timing?

Features of Spanish:

Increase in syllable duration not an important stress correlate.	d) Stressed syllables occur at reasonably regular intervals.
Tendency towards isochronous syllables.	e) Stressed syllables are only marginally longer than unstressed.
Rhythms of succession and alternation.	f) Within the most common group types (2,3,& 4-syllable groups), syllables tend to succeed each other at regular intervals.

3. Consonant-reducing or vowel-reducing?

Features of Spanish:

Consonant-reducing.	g) Consonant duration varies more than vowel duration which remains constant, thus giving the impression of syllable-timing.

Hypotheses (a) and (d) may appear to be contradictory but they are not necessarily so. The following is an example from the text examined, but average syllable durations from one of the informants have been used to make this clearer.

Consider the following utterance:

"Saquemos ejemplo de nosotros mismos" [sa'kemos e'xemplo ðe no'sotroz 'mizmos], it contains ten syllables (excluding "mismos"). If each syllable were given a durational value of 145 ms (averaged from LR's data), the intervals between stressed syllables would be unequal: ['kemose] = 435 ms, ['xemploðeno] = 580, ['sotros] = 290.

If, however, the word-timed stress groups were each allotted their average durations for group types, the following time relations would result:

[sa'kemos] = 432, [e'xemplo] = 432, [ðe no'sotros] = 566.

Here there is no two-syllable group and the four-syllable group is shorter, so the groups are more uniform in duration. However, this

also has the effect of narrowing the gap slightly between interstress intervals. Applying average durations again for this speaker's word-timed groups, the following durations would result:

	sa	'ke	mos	e	'xem	plo	ðe	no	'so	tros
Durations	144	144	144	144	144	144	137	137	155	137

giving ['kemose] = 432, ['xemploðeno] = 562, ['sotros] = 292.

The middle group has been reduced when compared to the first set of figures in which each syllable was given equal duration. Manipulation of duration is controlled within the word-timed groups so hypotheses (a) and (d) are perfectly compatible. Of relevance to this point is the discussion on beat and time in Chapter I.

The following features attributed to Spanish from the summary on page 263 are not dealt with in this chapter as they are considered to be established features of all speakers of the language:

With phonological word accent.

Fixed stress (compared to English).

Peripheral vowels.

Simple syllable structure.

Even distribution of syllable structure between stressed and unstressed syllables.

2. Method

2.1 Design

The following experimental steps were taken in order to examine the hypotheses listed in the introduction to this chapter.

2.1.1 Word-group-timing or leader-timing

2.1.1.1 Stress group variation

All word timed and leader-timed groups were measured and F tests for variance applied comparing a) all groups, and b) according to the number of syllables per group. T tests were also applied to groups to test means differences.

2.1.1.2 Syllable duration according to group type

Average durations and standard deviations of stressed and unstressed syllables according to the number of syllables per group were compared for each type of analysis, using T tests for means differences and F tests for variance.

2.1.1.3 Frequency of occurrence of stress group types and preferred durations

The frequency of occurrence of stress group types and preferred group durations were compared for both types of analysis.

2.1.2 Syllable-timing or stress-timing

2.1.2.1 Interstress intervals

All interstress intervals were measured and tested for variation (interstress intervals correspond to leader-timed groups).

2.1.2.2 Duration as phonetic feature accompanying stressed syllables

Ratios of all stressed and unstressed syllables were compared.

2.1.2.3 Rhythms of succession and alternation

To compare variation in duration of syllables, word-timed, and leader-timed groups, coefficients of variation were calculated on a selection of eight tone groups extracted from the Noah's Ark passage which were the same for each informant and which contained the most common stress group types, i.e. two, three and four-syllable groups. The statistical analysis of this section posed several problems: firstly, the syllable durations are obviously much shorter than the group durations; secondly, the syllables are much greater in number; and thirdly, the actual language material included in the word-timed and leader-timed groups cannot be exactly the same by definition. I was therefore advised to compare the measurements for each unit using the afore-mentioned coefficients.

Results were also compared with results from the whole passage as it was thought that the domain of timing control might be restricted to the tone group (cf. Rees, 1975).

2.1.3 Segment manipulation (consonant-reducing or vowel-reducing)

2.1.3.1 Segment manipulation within words

The duration of words progressively increased by one syllable was measured and compared to the average number of segments per second to find out whether words are subject to compression effects.

2.1.3.2 Segment manipulation according to segment type

Consonants and vowel durations were measured and compared according to the number of syllables per group. The phonetic environment was kept constant except for the addition of syllables to the word group.

2.2 Informants and Materials

The data used for 2.1.1 and 2.1.2 is the same passage, L'Arche de Noë, as that used in the previous chapter (Appendix 1). Five native speakers of Spanish recorded the text according to the procedure described below in Section 2.3. They were from different parts of the Spanish-speaking world: LR - Granada, Andalusia (but without a very noticeable Andalusian accent); AS - Caracas, Venezuela; JG - Madrid, Spain; JF - Ciudad Juarez, Mexico; DP - Salamanca, Spain. It is perhaps worth mentioning that all the informants are well-travelled and therefore regional variation may have been ironed out to a certain extent. No utterance-final syllables were used.

The data for 2.1.3.1 and 2.1.3.2 were seven basic mono-syllabic words to which it was possible to add unstressed syllables progressively, thus increasing the number of syllables per word. Each word was in the frame utterance "_____ siempre". The reason for the sample word being utterance initial in each case was that any word preceding it would have had to contain a stressed syllable, and as part of this experiment was to verify the hypothesis that duration is controlled within the word groups, it was necessary to place the sample word in this position to establish the effect of adding unstressed syllables prior to the stressed.[7] If the same word had been placed at the end of the utterance, it would have been affected by pre-pausal lengthening. The same five informants recorded these utterances.

7. For example, if "Diga ca'misa 'siempre" had been used, there are three unstressed syllables. As it has been found that syllable durations do decrease slightly, the more syllables there are between stresses, and ['diɣaka] contains three syllables, whereas ['misa] contains two, I thought it better to avoid possible effects by placing the variable utterance initially.

2.3 Procedure

2.3.1 Data

The passages and utterances for 2.1.1, 2.1.2, and 2.1.3.1, 2.1.3.2, were recorded under laboratory conditions at a comfortable reading speed for each informant, using the electrokymograph to give instrumental tracings of nasal and oral air-flow, speech wave form from the throat microphone and timing. A tape-recording was made simultaneously and although rather muffled, was sufficient for the informants to identify which syllables they considered as stressed from their own recordings. The vast majority of these coincided in all versions. Where there was any doubt, that syllable (or group) was not included in the data. Native speakers' intuition was also adhered to on syllable and word division. None of the informants was linguistically naive. I am satisfied that the accuracy of the measurements was adequate for the purposes of this experiment. As Lehiste points out:

> "The investigator making the measurements faces the question of the meaningfulness of the results. It appears pointless to attempt greater precision in measurement than is warranted by the speaker's ability to control his articulatory apparatus, on the one hand, and the hearer's ability to discriminate among durations, on the other"
> (Lehiste, 1970 : 10).

The segmentation of the five versions of Noah's Ark is contained in Appendix 6. Any dubious measurements have been omitted from the data and so also have utterance final measurements as these were not used in any of the tests. As there were insufficient six-syllable groups for the data to be valid, only one to five-syllable groups were used.

Segmentation of the utterances for Section 2.1.3.1 and 2.1.3.2 is contained in Appendix 7. Here all measurements have been included and those relevant to each particular consonant or vowel are indicated in the appropriate section.

2.3.2 Segmentation techniques

The data is analyzed by the two methods described in the previous chapter: leader-timed groups and word-timed groups (pp. 162-165). Group boundaries in both cases coincide with phonological syllable boundaries, a decision also adopted by Roach in his essay "On the distinction between 'stress-timed' and 'syllable-timed' languages" and previously mentioned in Chapter I. The full quote is repeated for convenience:

> "If it were possible to identify what have been called P-centres (Morton et al., 1976) from the production side of speech..... there would be much to be said for measuring from these. However, in the present state of our knowledge it is felt to be intuitively more satisfying to aim to measure as nearly as possible from the PHONOLOGICAL beginning of the syllable...." (Roach, 1982 : 76).

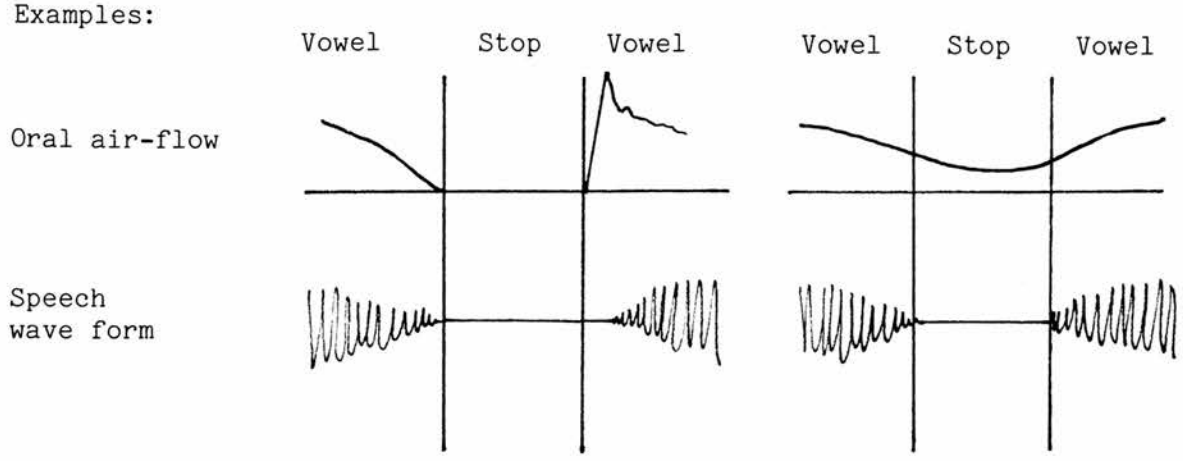
Word-timed group boundaries also coincide with phonological word boundaries except in the case of adverbs ending in "mente" (cf. Chapter V, p. 164). Where a word-final consonant is followed in the utterance by a word-initial vowel, the duration of the consonant has been allotted to the first word. Reasons for this are given in the previous chapter. Where sinalefa occurs, the duration of the resulting syllable is allotted to the first word.

Apart from the above general criteria, the following system has been consistently followed for segment division:

The duration of geminate consonants has been split equally between the two syllables involved, e.g. [elleon] (the lion).

Any aspiration following voiceless oral stops has been allotted to the following vowel unless there was no evidence of complete closure, in which case the vowel has been measured from the onset of voicing.

Examples:



Intervocalic nasal consonants usually have the effect of nasalizing the post-nasal vowel rather than the pre-nasal. Segmentation lines between nasals and following vowels have been drawn at the point where the wave form clearly changes. Typical nasal periodic wave-form tracings are usually more uniform than those of vowels. The more complex tracings typical of vowels (corresponding to more formant structure) are not nearly so noticeable, if there at all. The following vowel is usually initiated at the highest peak of the nasal air-flow. Examples of these are all included in Figure 41.

Abutting consonants, voiceless fricative plus stop, such as [st] are normally divisible by the oral air-flow but where this is not clear, the segmentation line has been drawn at the point of least air-flow.

Examples:

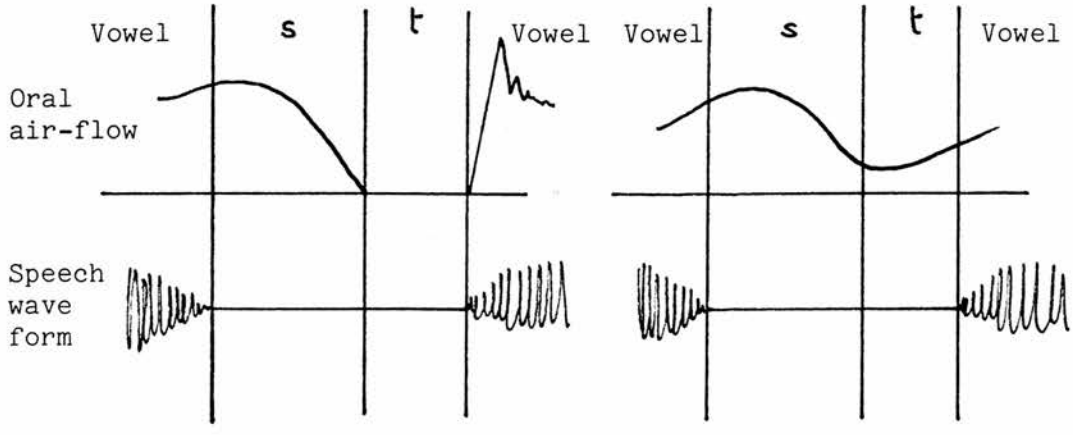


Figure 41

Examples of segmentation techniques of Noah's Ark, Spanish. Informant DP.

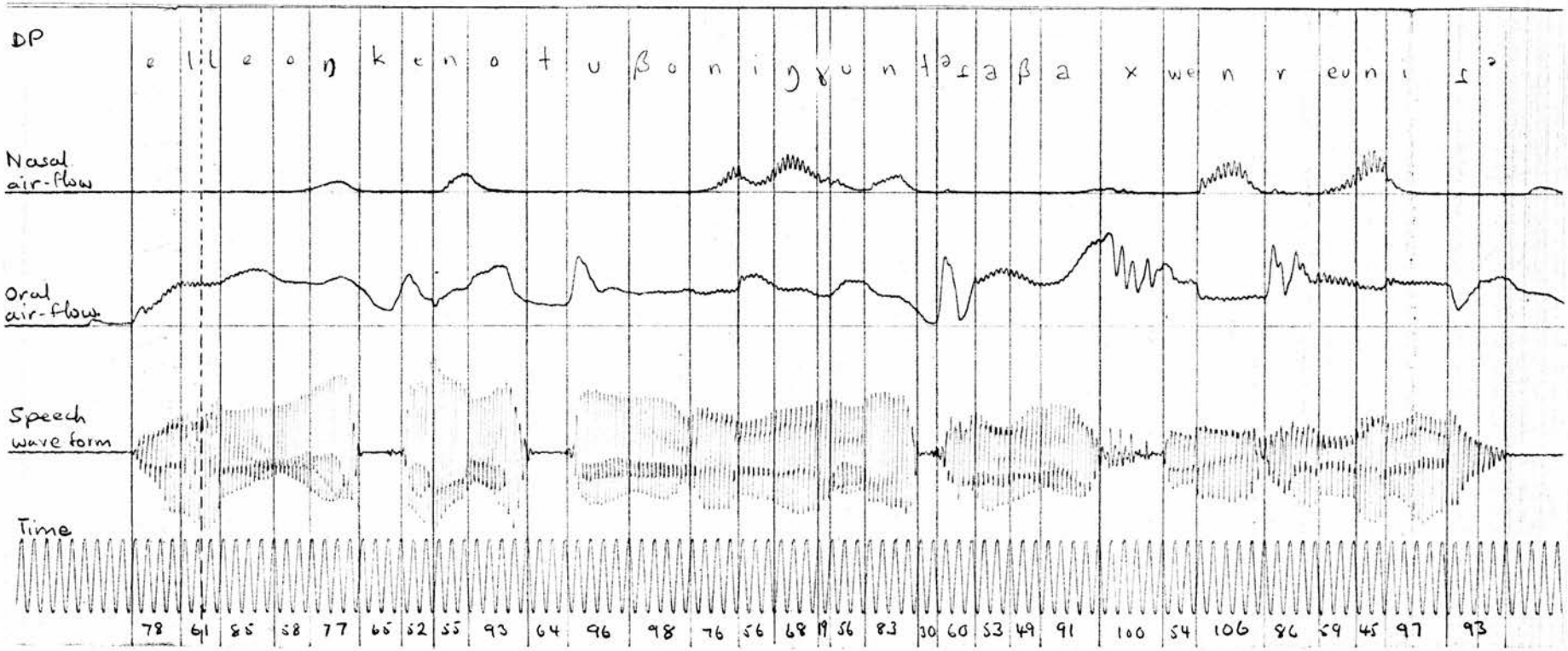
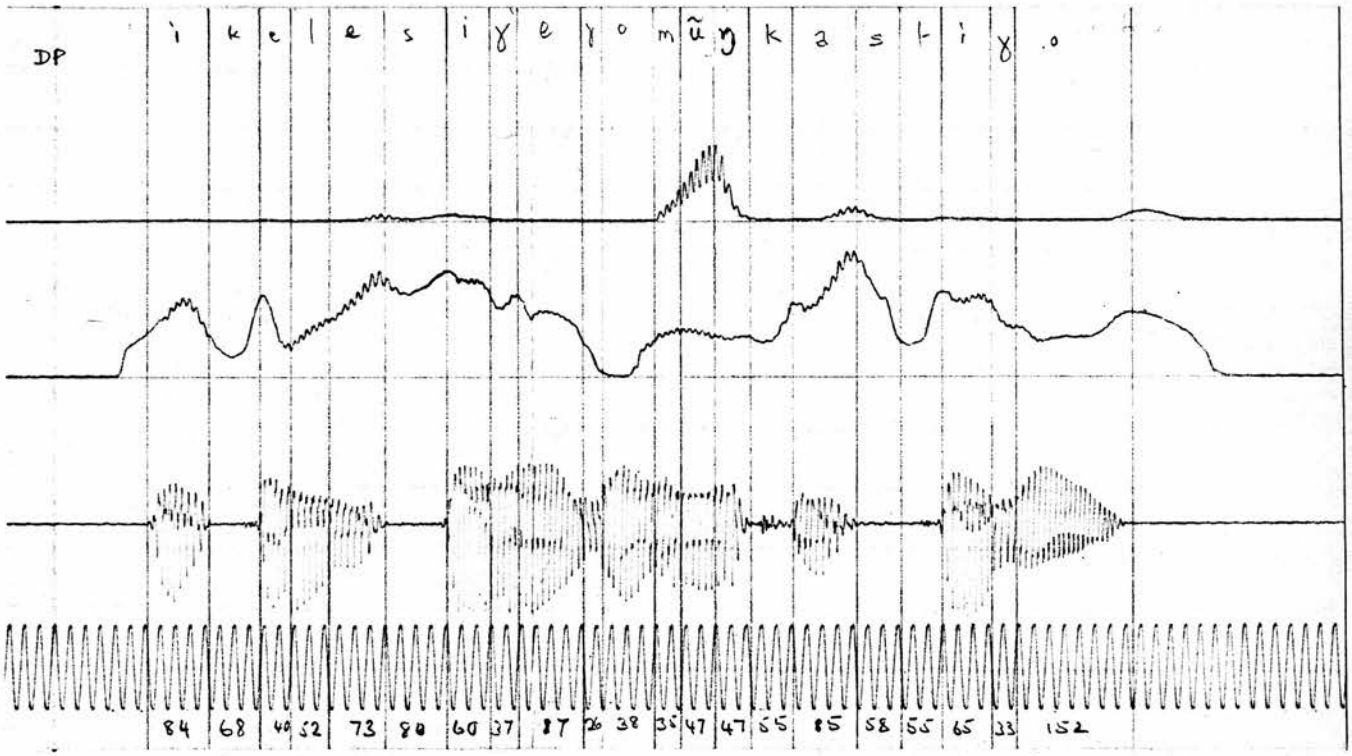


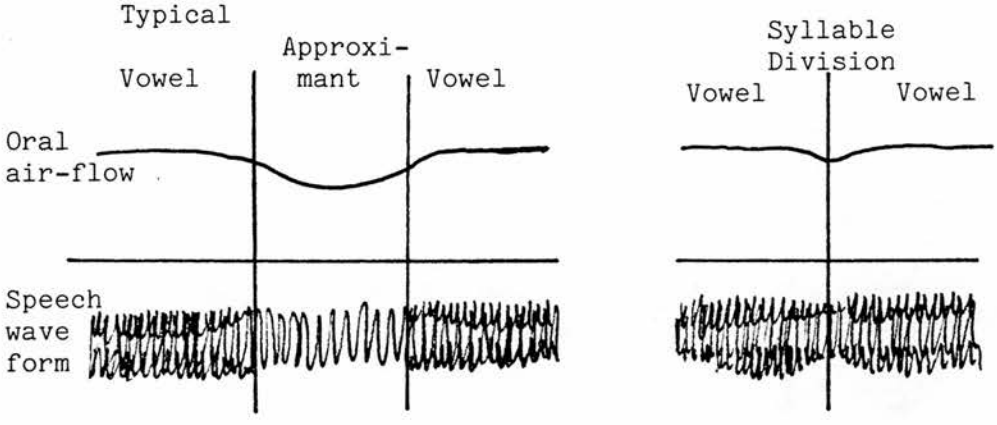
Figure 42

Examples of segmentation techniques of Noah's Ark, Spanish. Informant DP.



Voiced fricatives and approximants are often difficult to segment but many are characterized by a typical dip in the oral air-flow accompanied by a change in the wave form, again the absence of more complex periodic tracings. Where this is not present, the syllable division has been made at the point of least air-flow or change in the wave form.

Examples:



See also Figure 42.

Where two voiced approximants occur contiguously, half the combined duration has been allotted to each syllable.

The duration of the epenthetic vowel [ə] has been counted together with its adjacent tap [r] (Figure 41).

Utterance-initial voiceless stops have been given a durational value which is the average for intervocalic voiceless stops from approximately half the text for each informant. The values are the following to the nearest millisecond:

	/p/	/t/	/k/
LR	55	38	39
AS	50	48	48
JG	48	44	45
JF	56	63	59
DP	47	41	44

As only syllable and stress group durations were needed for the tests performed on the Noah's Ark data, segmentation within the syllable was not important, except to establish the above voiceless stop durations.

Certain difficulties were encountered in the data for 2.1.3.1 and 2.1.3.1 "_____ siempre" which will be referred to as the "chico" series. Segmentation of the sound combinations [iλo] or [ijo] in "chiquitillo", [iλa] in "camisetilla" and [reaδm] in "readmito" was impossible, so although durations of the complete words were used (this time not including those of the initial voiceless stops), those of the above segments were omitted from the data testing individual segment reduction.

3. Results

3.1 Word-group-timing or Leader-timing

3.1.1 Stress group variation

In the previous chapter, it was found that there was a significant difference in variation between the Spanish data analyzed according to different types of stress groups: word-group-timing < leader-timing. The same experiment was repeated with data from five native speakers of Spanish. Results obtained from the measurements of all non-utterance final groups (according to Appendix 6) are presented in Table 47 and Figures 43 and 44.

The table and figures indicate that each speaker produced more variation in duration of leader-timed stress groups than word-timed. The differences however were small on the whole and F tests showed they were not significant, the closest being that of JG who was the informant used in the previous chapter. At the same time, it must be

Figure 43

Average durations and standard deviations of all non-final word-group-timed and leader-timed stress groups.
Spanish Noah's Ark.

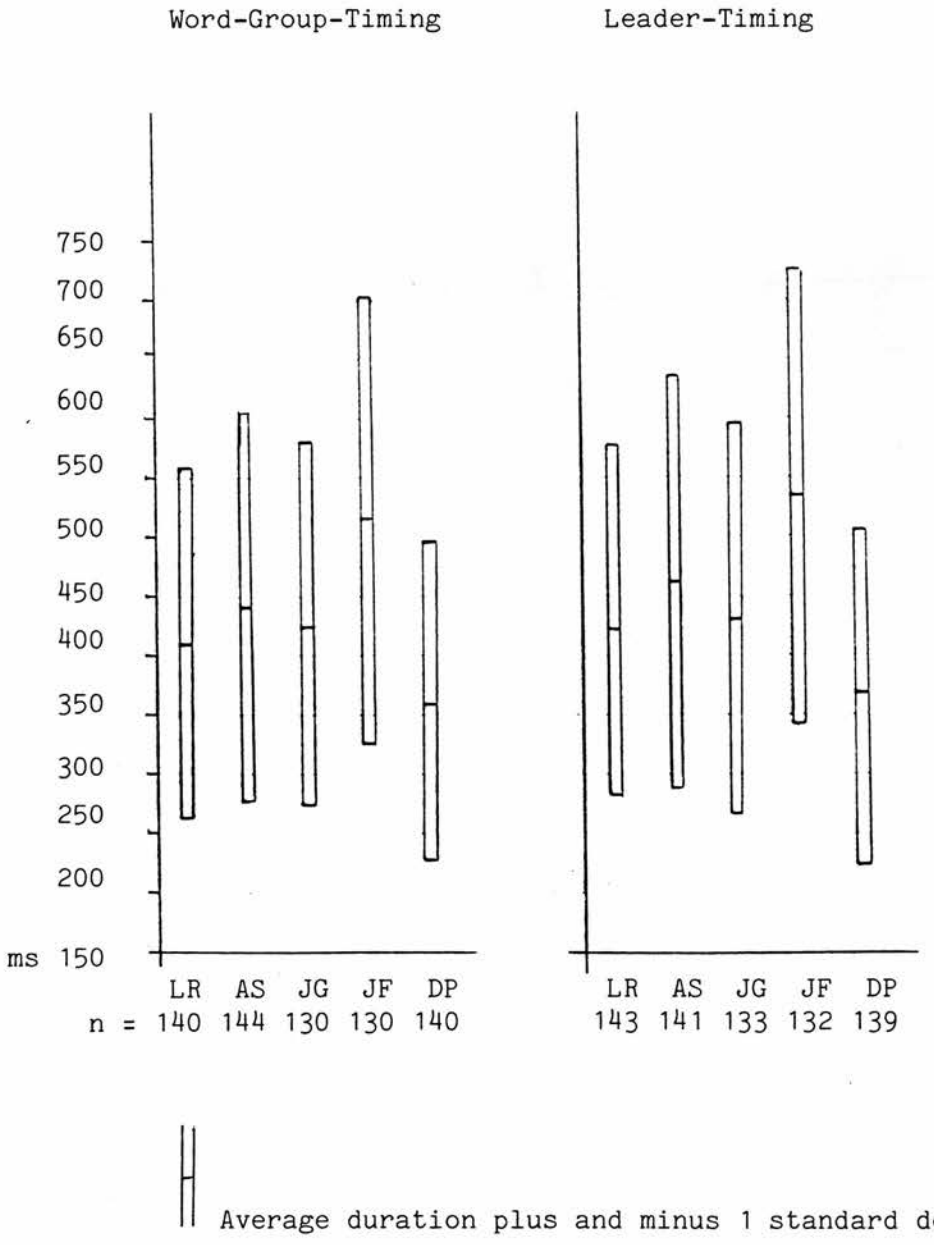
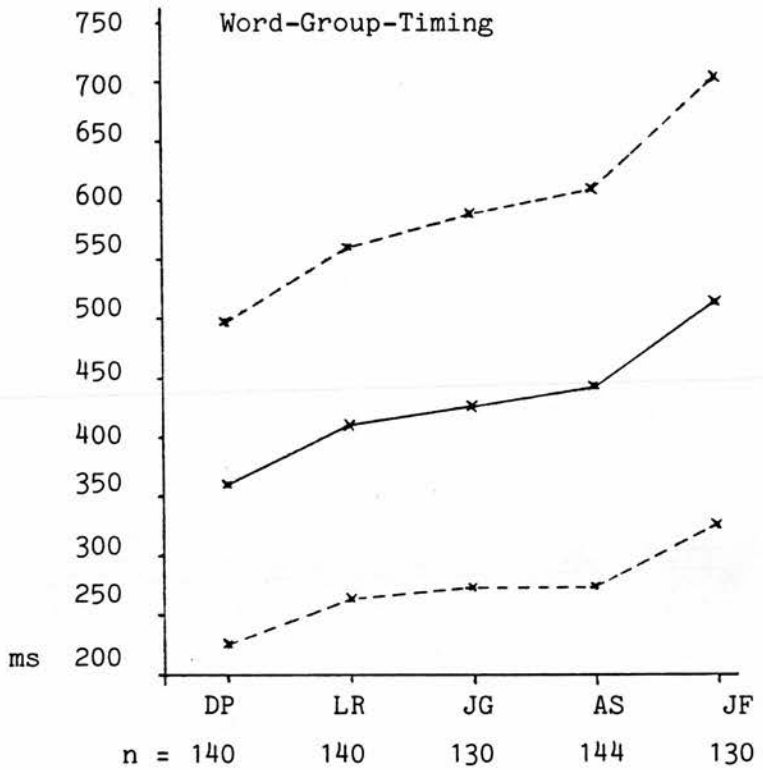


Figure 44

Average durations of non-final stress groups plus and minus 1 standard deviation (shortest to longest), Spanish, Noah's Ark.



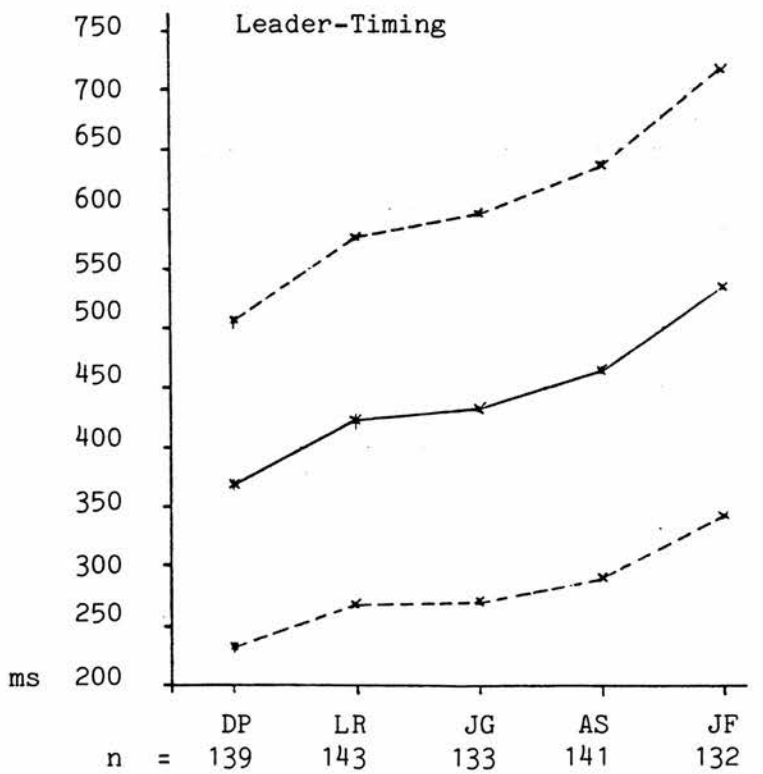


TABLE 47

Average durations and standard deviations of all non-final stress groups. Spanish Noah's Ark (to nearest ms).

	Word-group-timing			Leader-timing		
Informant	N	AD	SD	N	AD	SD
LR	140	411	148	143	422	154
AS	144	440	168	141	462	173
JG	130	425	153	133	431	163
JF	130	514	188	132	534	192
DP	140	360	134	139	369	136

N = Number
AD = Average duration
SD = Standard deviation.

remembered that only the extreme durations of which there are comparatively few, would be expected to show up the differences between the analyses. This point will be referred to later.

The three lines in each part of Figure 44 correspond to average durations of stress groups of all speakers plus and minus one standard deviation in ascending order (or fastest to slowest speaker). It is clear from this graph and the figures in Table 47 that there is a correlation between variance and duration, i.e. standard deviations increase in proportion to the increase in averages. F tests applied to the data showed there to be significant differences between JF and JG ($F = 1.51$, $p < .05$), JF and LR ($F = 1.61$, $p < .01$), JF and DP ($F = 1.97$, $p < .01$) and AS and DP ($F = 1.57$, $p < .05$). However, it is to be expected in speech that variation in units measured will increase as speech tempo decreases and in fact,

variation coefficients ($\frac{SD}{\bar{x}}$ x 100) were almost identical for all informants, LR 36%, AS 38%, JG 36%, JF 36.5%, DP 37%. These figures comparing speakers are based on the word-group-timing analysis as there was little difference between speakers in the two analyses. Figure 45, average durations of all non-final word-timed groups, shows similarity between speakers and the extent to which averages of five-syllable groups cover a greater range than those of one-syllable groups which are clustered together. This agrees with Klatt's theory that segments will resist becoming shorter but not becoming longer (Klatt, 1973 : 1102-1104).

It might be expected that if timing is controlled within the word-timed stress groups, there would be less variation among groups containing the same numbers of syllables than the leader-timed groups. Variation was tested for all speakers and the results presented in Table 48. There was no difference in variation according to group type, the only significant figure being the last (DP five-syllable groups) in which the word-timed groups show greater variation.

There is very little difference between average durations of two, three and four-syllable groups in the two analyses but what is clear from the table is that all one-syllable leader-timed groups are considerably shorter than word-timed groups and all five-syllable leader-timed groups, considerably longer than their counterparts except DP's which are equal. T tests were applied to the data comparing the two analyses for each group type but the results were not significant.

Figures 46 and 47 show average durations of word-timed and leader-timed groups respectively, indicating by the dotted line what the increment in duration would be if it were proportional to the

Figure 45

Average durations of word-timed stress groups according to number of syllables per group.
Spanish, Noah's Ark.

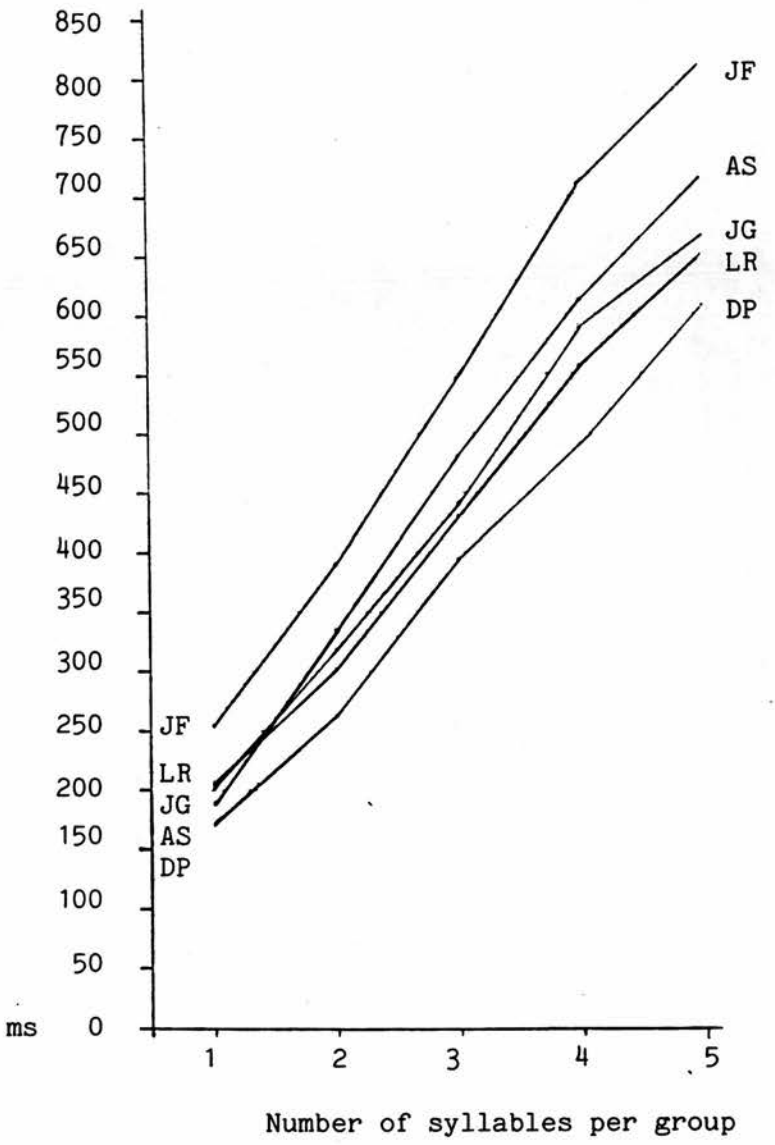


TABLE 48

Average durations, standard deviations and F tests of all non-final groups according to number of syllables per group. Spanish, Noah's Ark (ms).

Informant	N° syl /group	Word-group-timing AD	SD	N	Leader-timing AD	SD	N	F Variance
LR	1	210	57	9	184	77	8	L > W, F=1.82, Not sig.
	2	301	70	52	306	66	50	W > L, F=1.12, "
	3	433	74	45	445	73	44	W > L, F=1.03, "
	4	559	75	22	536	98	30	L > W, F=1.71, "
	5	652	65	10	718	86	8	L > W, F=1.75, "
AS	1	189	57	10	172	36	9	W > L, F=2.51, "
	2	326	78	56	340	81	50	L > W, F=1.08, "
	3	479	82	44	482	64	38	W > L, F=1.64, "
	4	613	92	23	601	104	31	L > W, F=1.28, "
	5	714	64	10	722	65	10	L > W, F=1.03, "
JG	1	202	52	9	162	61	9	L > W, F=1.38, "
	2	319	63	50	310	60	45	W > L, F=1.10, "
	3	442	70	39	456	68	41	W > L, F=1.06, "
	4	592	83	21	558	78	25	W > L, F=1.13, "
	5	666	63	10	706	102	10	L > W, F=2.62, "
JF	1	254	62	10	202	58	9	W > L, F=1.14, "
	2	391	85	51	394	73	45	W > L, F=1.36, "
	3	549	83	37	570	82	38	W > L, F=1.02, "
	4	711	128	23	679	103	29	W > L, F=1.54, "
	5	811	89	8	859	104	8	L > W, F=1.36, "
DP	1	171	46	10	141	29	9	W > L, F=2.52, "
	2	263	51	55	262	53	51	L > W, F=1.08, "
	3	394	69	43	406	61	42	W > L, F=1.28, "
	4	490	70	21	488	68	27	W > L, F=1.06, "
	5	609	69	10	610	33	8	W > L, F=4.37, $p < .05$

syl = syllable; AD = Average duration; N = Number
SD = Standard deviation; L = Leader-timing;
W = Word-timing.

addition of the average duration of one unstressed syllable per group, taking two-syllable groups as a reference point. These graphs will be referred to in the following section but relevant here are the general shapes of the graphs which are similar for all informants in the word-timed analysis. One-syllable groups are all longer than they would be if they were shorter by the average duration of one unstressed syllable than two-syllable groups. Average durations of two, three and four-syllable groups are almost in proportion to the addition of the average duration of one unstressed syllable (with the exception of DP) and five-syllable groups are all shorter than they would be if they were in proportion to the addition of one unstressed syllable duration to four-syllable groups.

Figure 47, on the other hand, shows less consistency between speakers. LR's one-syllable groups are longer than they would be if in proportion, whereas those of AS, JG and JF are shorter, and DP's the same. All average durations of five-syllable groups are shorter than expected (except those of LR) but the general shapes of the graphs are different for each speaker.

Although the results of this section are not statistically significant, certain tendencies are apparent, namely that there is less variation in the word-timed groups than the leader-timed and that average durations of one and five-syllable word-timed groups are closer to the central tendencies of all groups than those of leader-timed.

3.1.2 Syllable duration according to group type

The results of this section concern hypothesis b), that the duration of stressed and unstressed syllables depends to a certain extent on the number of surrounding or adjacent syllables within these groups.

Figure 46

Average duration of word-timed stress groups according to number of syllables per group, indicating predicted increment proportional to the addition of one unstressed syllable (2-5 syllable groups). Spanish, Noah's Ark.

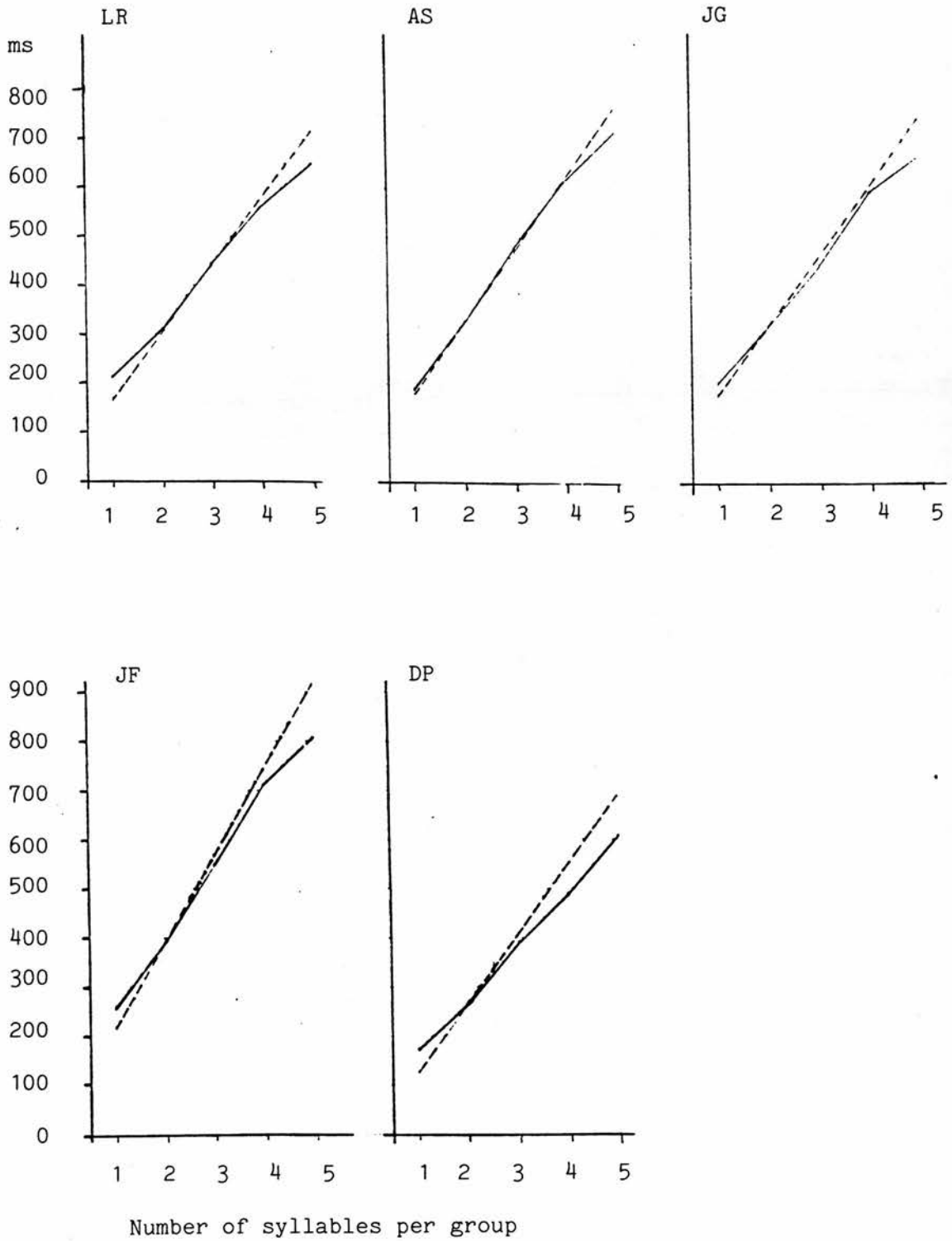


Figure 47

Average duration of leader-timed stress groups according to number of syllables per group, indicating predicted increment proportional to the addition of one unstressed syllable (2-5 syllable groups).
Spanish, Noah's Ark.

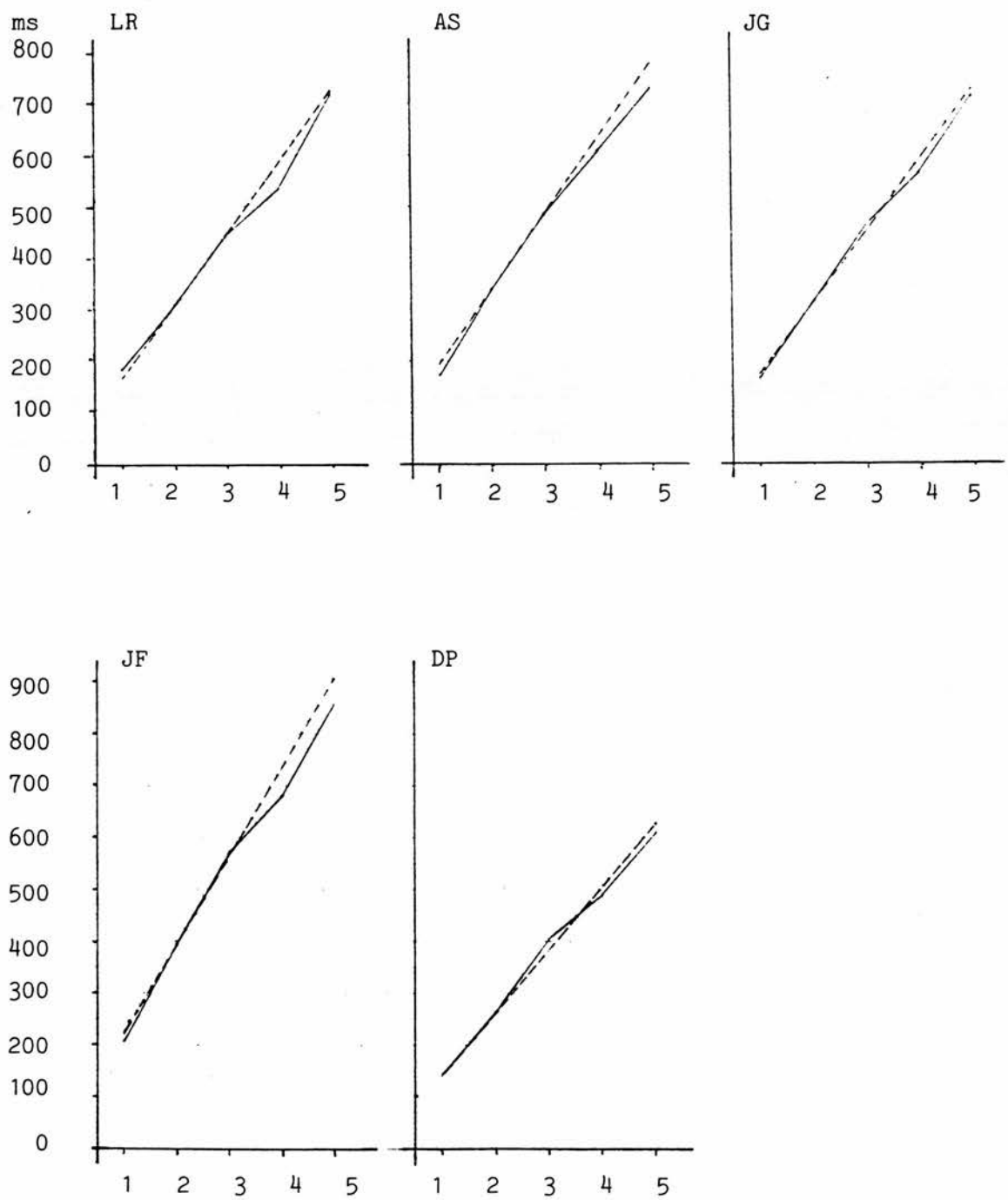


Figure 48

Average durations of stressed and unstressed syllables according to number of syllables per stress group. Spanish, Noah's Ark.

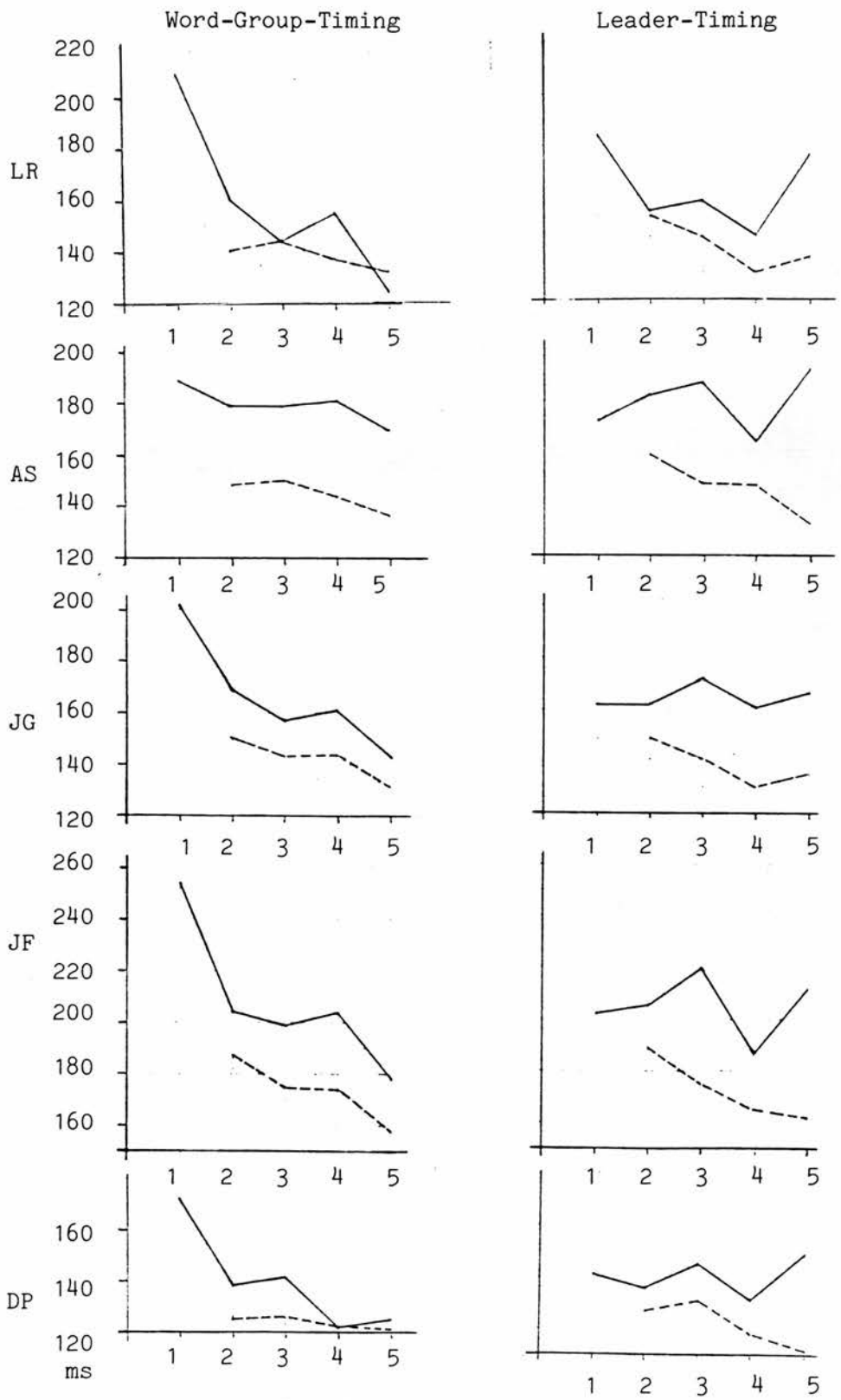


Figure 49

Average durations and standard deviations of stressed and unstressed syllables according to stress group type. Spanish, Noah's Ark.

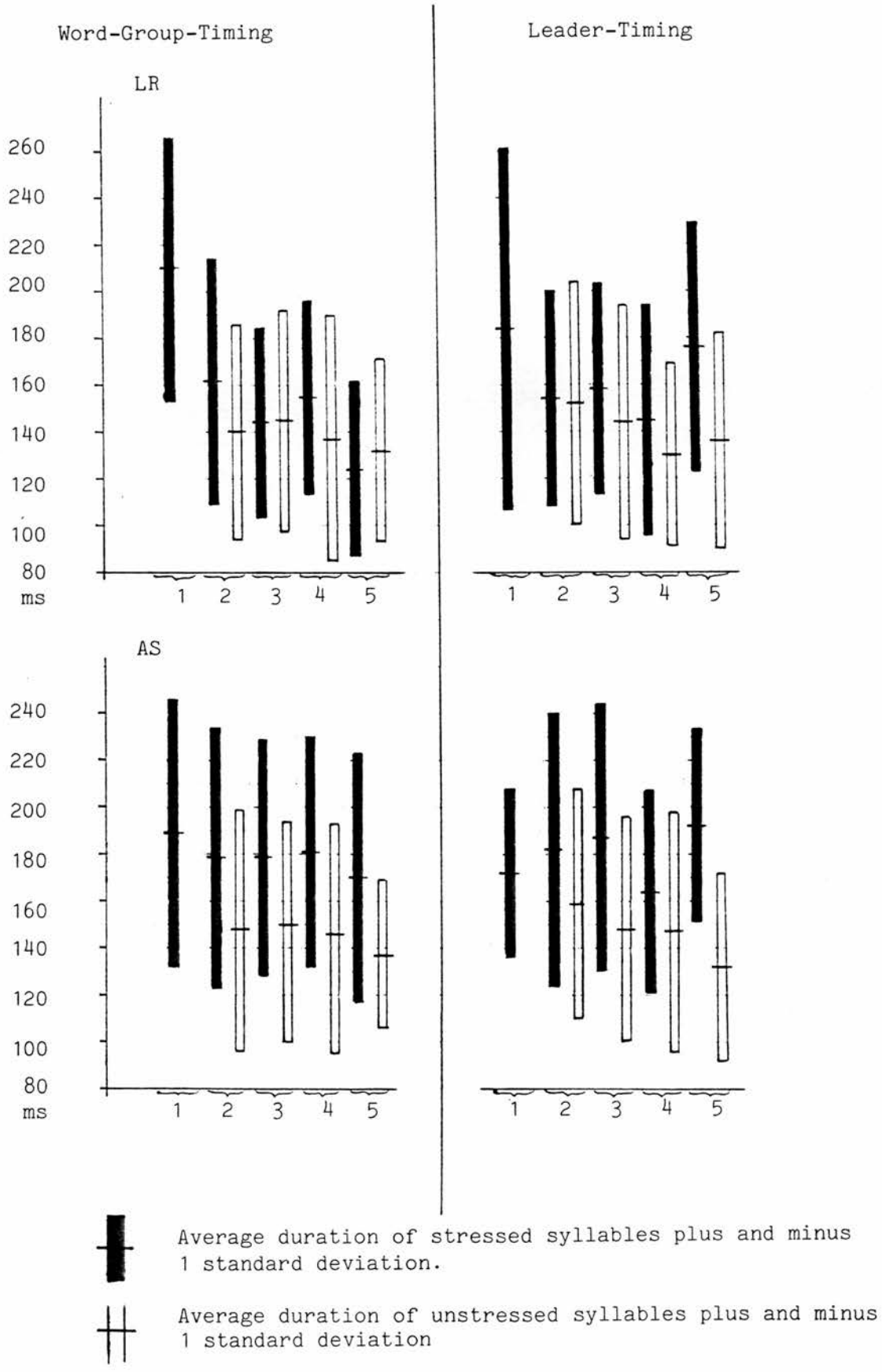


Figure 49 (continued)

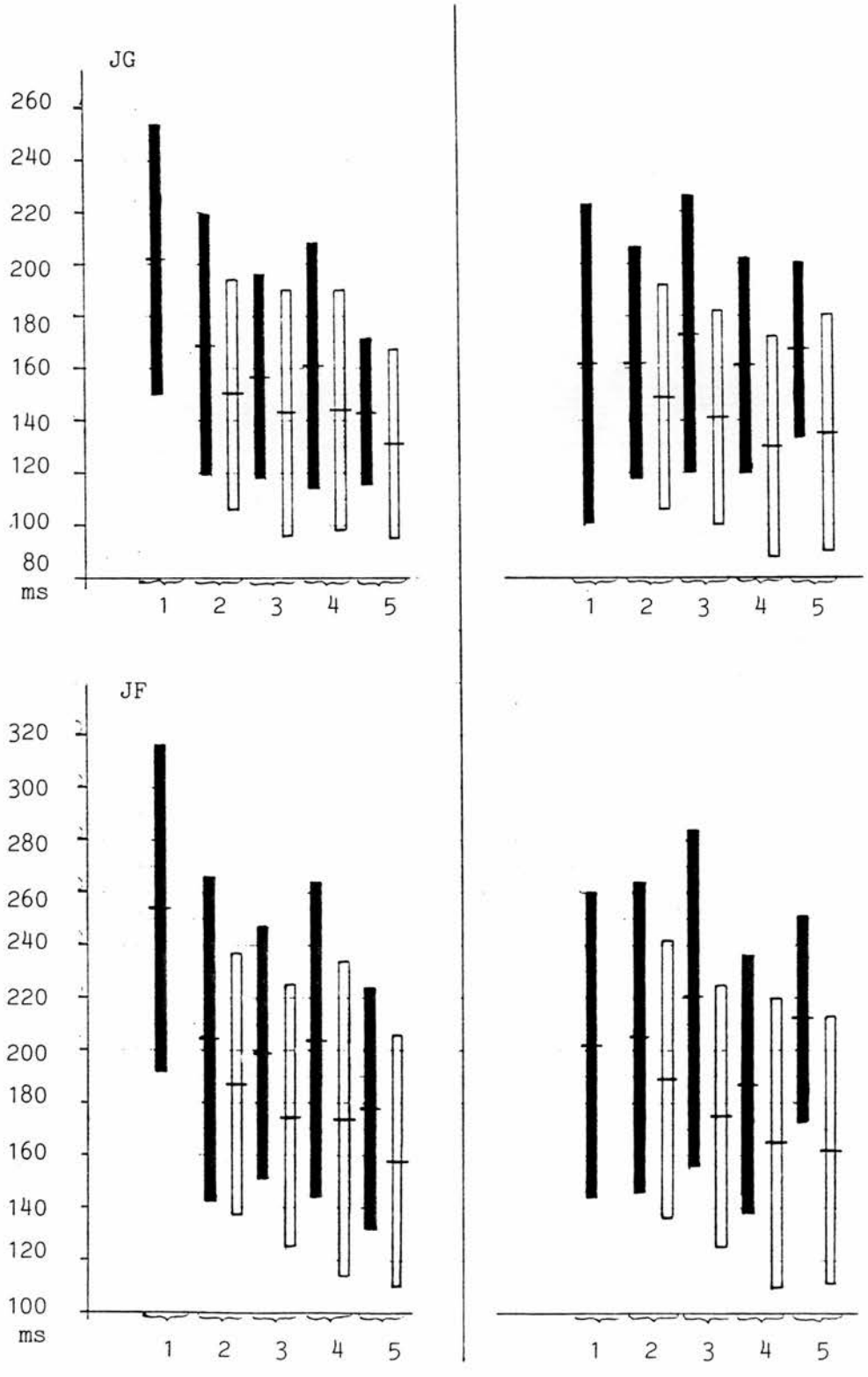
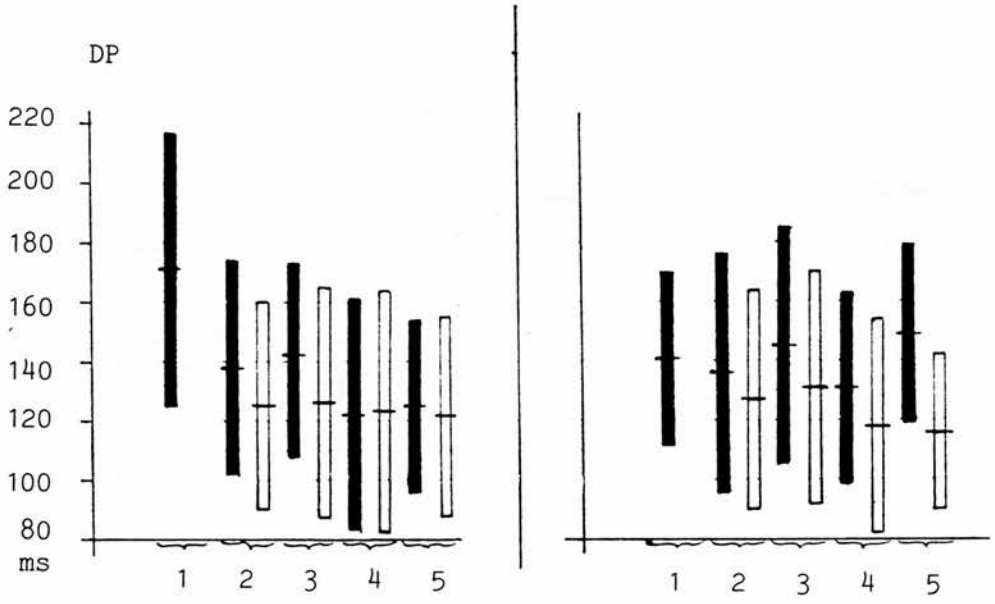


Figure 49 (continued)



Number of syllables per stress group

TABLE 49

Average duration and standard deviation of stressed and unstressed syllables according to number of syllables per group (to nearest ms).
Spanish, Noah's Ark.

		Word-Group-Timing						Leader-Timing					
Infor-	N° syl	Stressed			Unstressed			Stressed			Unstressed		
mant	/group	AD	SD	N	AD	SD	N	AD	SD	N	AD	SD	N
LR	1	210	57	9				184	77	8			
	2	161	53	52	140	46	52	154	46	50	152	52	50
	3	144	41	45	144	47	90	158	45	44	144	50	88
	4	155	41	22	137	52	66	145	49	30	130	39	90
	5	124	37	10	132	39	40	176	53	8	136	46	32
AS	1	189	57	10				172	36	9			
	2	179	55	56	148	52	56	182	58	50	159	49	50
	3	179	50	44	150	46	88	187	57	38	148	48	76
	4	181	49	23	144	49	69	164	43	31	147	51	93
	5	170	53	10	137	32	40	192	41	10	132	40	40
JG	1	202	52	9				162	61	9			
	2	169	50	50	150	44	50	162	44	45	149	43	45
	3	157	39	39	143	47	78	173	53	41	141	41	82
	4	161	47	21	144	46	63	161	41	25	130	41	75
	5	143	28	10	131	36	40	167	33	10	135	45	40
JF	1	254	62	10				202	58	9			
	2	204	62	51	187	50	51	205	59	45	189	53	45
	3	199	48	37	175	49	74	220	64	38	175	50	76
	4	204	60	23	174	60	69	187	49	29	165	55	87
	5	178	46	8	158	48	32	212	39	8	162	51	32
DP	1	171	46	10				141	29	9			
	2	138	36	55	125	35	55	136	40	51	127	37	51
	3	142	34	43	126	39	86	145	40	42	131	39	84
	4	122	39	21	123	42	63	131	32	27	118	36	81
	5	125	29	10	121	34	40	149	30	8	112	26	32

syl = syllables; AD = Average duration;
SD = Standard deviation; N = Number.

Average durations and standard deviations of stressed and unstressed syllables were compared for each type of analysis and group. The results are presented in Figures 48 and 49 and Table 49.

Figure 49 contains average durations plus and minus one standard deviation of stressed and unstressed syllables according to the number of syllables per group and type of analysis for each informant. The general shapes of the graphs show certain consistencies between speakers. All stressed syllables are longer on average than unstressed, except LR three and five-syllable word-timed groups and DP four-syllable word-timed groups. In one-syllable word-timed groups the stressed syllable is longer on average than in all others (word and leader-timed) and stressed and unstressed syllables of five-syllable word-timed groups are shorter on average than the corresponding syllables in the leader-timed analysis except AS and DP, unstressed (Table 49). The difference between stressed and unstressed syllables, both in average durations and range of standard deviation tends to remain constant in the word-group-timed analysis but not in the leader-timed. This is better illustrated in Figure 48 where clearly the word-group-timed graphs for each speaker show the same general tendencies for average durations of stressed and unstressed syllables, whereas the stressed syllables in the leader-timed graphs differ from speaker to speaker and do not follow the tendency of the unstressed syllables to decrease in duration as the number of syllables per group increases.

It is worth pointing out certain differences between speakers. Average durations of stressed and unstressed syllables of the Venezuelan informant, AS, are kept quite separate and to a lesser extent those of JF (Mexican). The two Latin-American informants also

have similar graphs in the leader-timed analysis. JG and DP, both from Castile and with very similar accents, show similar tendencies to some extent, but DP's stressed syllables of four-syllable groups are much shorter. The lower limits of standard deviations (Figure 49) of all informants lie within a narrow range between 80 and 110 ms (the majority falling between 80 and 100 ms). DP was a very fast speaker and had already reached this lower limit in four-syllable groups so presumably could not increase his speech rate any further in five-syllable groups. In the upper limit on the other hand, there is a range of 100 ms between DP and JF.

The following tests were applied to the data:

a) F tests for variation between syllable durations, stressed and unstressed together (word-group-timing compared to leader-timing) according to group type.

   Only two of these tests were statistically significant:

   LR Leader < Word, five-syllable groups, $F=1.66$, $p < .05$.

   JF Leader < Word, three-syllable groups, $F=1.38$, $p < .05$.

   Although more groups showed greater variation of syllable duration in the leader-timed analysis than in the word-timed, the difference between the two was very small.

   Average durations and standard deviations of syllables according to group type are presented in Table 50.

b) T tests for means differences between syllable durations, stressed and unstressed together (word-group-timing compared to leader-timing) according to group type.

   These tests did not show any significant differences between the two analyses for individuals but all one-syllable groups of the word-group-timed analysis were significantly longer than those of the leader-timed, $T = 2.81$, $p < .05$. All syllables of five-

TABLE 50

Average durations and standard deviations of syllables according to number of syllables per group (to nearest ms) Spanish, Noah's Ark.

	N° of sylls per group	Informant									
		LR		AS		JG		JF		DP	
		AD	SD	AD	SD	AD	SD	AD	SD	AD	SD
Word-Timing	1	210	57	189	57	202	52	254	62	171	46
	2	151	50	164	56	160	49	196	58	132	37
	3	145	46	160	49	148	45	183	50	133	39
	4	142	50	153	53	149	47	182	61	121	41
	5	130	39	143	39	132	36	164	47	123	34
Leader-Timing	1	184	77	172	36	162	61	202	58	141	29
	2	153	50	169	57	157	44	198	57	132	38
	3	149	49	161	56	151	48	191	59	137	42
	4	135	43	152	51	138	44	170	54	122	36
	5	144	50	145	47	142	45	173	54	118	33

sylls = syllables; AD = Average duration; SD = Standard deviation.

syllable groups were considerably shorter but the value was not significant, T = 1.62.

c) F tests for variation between stressed and unstressed syllables separately, according to group type (data in Table 49).

There was very little difference in variation between leader-timed and word-timed groups, only three sets showing any significance: LR unstressed syllables of four-syllable groups, word > leader, $F = 1.78$, $p < .01$, JG and JF, stressed syllables of three-syllable groups, leader > word, $F = 1.85$, $p < .05$; $F = 1.78$, $p < .05$ respectively.

d) T tests for means differences between the two analyses, stressed and unstressed syllables separately, according to group type (data in Table 49).

Although all leader-timed stressed syllable average durations in five-syllable groups were considerably longer than those in the corresponding word-timed groups, only LR's were significantly different, $T = 2.39$, $p < .05$. Considering all informants together however, the result was highly significant for the same syllable type. Leader > Word, $T = 3.56$, $p < .01$. This shows that syllable duration in the longer groups is being manipulated within the units established by word-group-timing and not by leader-timing. One-syllable group results have already been given (cf. b, same section)

e) T tests for means differences between syllables, stressed and unstressed separately, of one to five-syllable groups, word-timed analysis; idem leader-timed analysis (see Table 49 for average durations).

These tests were on the whole significant for all informants. The results are presented in Table 51.

Although AS's results were not significant, they followed the same general tendencies. All stressed syllables of one-syllable groups were considerably longer than those of two, three and four-syllable groups in the word-group-timed analysis. LR's results were also significant between stressed syllables of two and five-syllable groups and DP's between those of three and four-syllable groups. The only significant result for word-group-timed unstressed syllables was between those of two and five- syllable groups JF, who also had a significant result in the leader-timed analysis between the same syllable types.

The above tests indicate that there is little difference in variation of syllable duration according to group type between the two analyses whether the syllables are considered together or further classified

TABLE 51

Means differences between syllables (stressed and unstressed separately) of one to five-syllable groups within each analysis. Spanish, Noah's Ark.

Significant T tests

Word-group-timing

LR	Stressed syllables of	1-syllable groups	>	2-syllable groups, T = 2.53, p< .05
				3-syllable groups, T = 4.16, p< .01
				4-syllable groups, T = 3.01, p< .01
				5-syllable groups, T = 3.93, p< .01
		2-syllable groups	>	5-syllable groups, T = 2.14, p< .05
AS	Results not significant.			
JG	Stressed syllables of	1-syllable groups	>	3-syllable groups, T = 2.91, p< .01
				4-syllable groups, T = 2.11, p< .05
				5-syllable groups, T = 3.12, p< .01
JF	Stressed syllables of	1-syllable groups	>	2-syllable groups, T = 2.31, p< .05
				3-syllable groups, T = 3.29, p< .01
				4-syllable groups, T = 2.17, p< .05
				5-syllable groups, T = 2.86, p< .05
	Unstressed syllables of	2-syllable groups	>	5-syllable groups, T = 2.64, p< .01
DP	Stressed syllables of	1-syllable groups	>	2-syllable groups, T = 2.57, p< .05
				3-syllable groups, T = 2.28, p< .05
				4-syllable groups, T = 3.09, p< .01
				5-syllable groups, T = 2.68, p< .05
		3-syllable groups	>	4-syllable groups, T = 2.06, p< .01

Leader-timing

LR, AS, JG, DP	: Results not significant			
JF	Unstressed syllables of	2-syllable groups	>	5-syllable groups, T = 2.27, p< .05

into stressed and unstressed. However, tests for means differences proved significant between the two analyses, particularly for stressed syllables which are, a) longer in word-group-timing than leader-timing one-syllable groups, and shorter in word-timing than leader-timing, five-syllable groups, and b) show significant differences between groups in the word-group-timing analysis but not in the leader-timing.

It would appear therefore that on the whole syllable durations are manipulated to a greater extent in the word-group-timed analysis than in the leader-timed, but that the distribution of the majority of syllable durations in the two analyses within their group types is kept relatively constant. One and five-syllable groups are the most affected, there being very little difference between syllables of two, three and four-syllable groups within the same analysis or across analyses.

3.1.3 Frequency of occurrence of stress group types and preferred durations

The results of this section concern hypothesis c), that there are upper and lower preferred durational limits to stress groups (depending on individual speech tempo) and speakers will tend to avoid exceeding these limits. This tendency is expected to be apparent in the word-timed groups.

The frequency of occurrence of stress group types (based on the number of syllables per group) was very similar for both types of analysis. All groups, final and non-final were taken into account. The numbers for word-timing have already been given in the previous chapter but are tabulated again here for convenience:

Number of stress groups classified by number of syllables per group

Number of syllables per group	1	2	3	4	5	6	7	8
Number of groups : word-group-timing	10	67	59	37	17	1		1
Number of groups : leader-timing	16	87	47	29	10	4		

Although there are considerably more two-syllable groups in the leader-timed count due to utterance-final groups almost always containing two syllables reflecting the preference for words to be stressed penultimately, preferred group types are those containing

two, three and four syllables. These make up 85% of all word-timed groups and 84.5% of leader-timed. There are fewer word-timed groups of one and six syllables than leader-timed. The average number of syllables per groups for word-timing is almost 3 (2.96) and for leader-timing 2.7.

Preferred stress group durations for both types of analysis are contained in Table 52 and Figure 50. The white areas in the graph correspond to 75% of stress groups (actual figures are given in Table 52). There is very little difference between the two analyses and any slight variation is contained within the shaded areas corresponding to the more extreme durations, particularly in the upper section of the range. The range within which 75% of the groups are contained increases as the speech rate of the informants decreases; the fastest speaker, DP, having a range of 315 ms, and JF, the slowest, 421 ms.

TABLE 52

Preferred stress group durations in ms.

Spanish, Noah's Ark.

		All groups		75% of groups	
	Informant	between	range of	between	range of
Word-Group-Timing	LR	115- 838	723	236-595	359
	AS	112- 893	781	250-639	389
	JG	137- 878	741	269-619	350
	JF	176-1081	905	312-733	421
	DP	115- 715	600	213-528	315
Leader-Timing	LR	104- 894	790	256-612	356
	AS	121- 990	869	262-666	404
	JG	97- 873	776	258-604	346
	JF	140-1061	921	317-746	429
	DP	102- 778	676	212-539	327

Figure 50

Histograms of stress group duration as percentage of total number of non-final groups. Spanish, Noah's Ark.

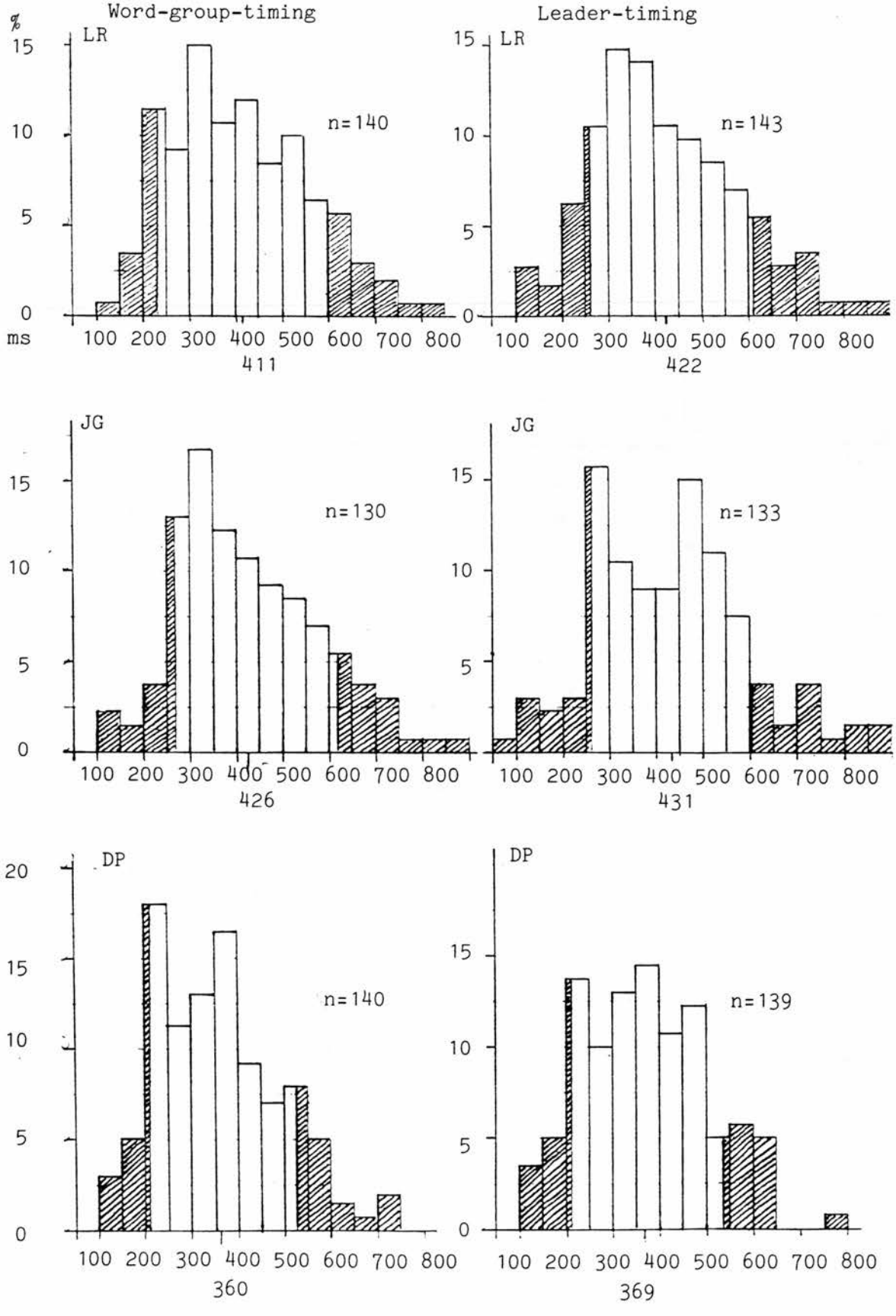
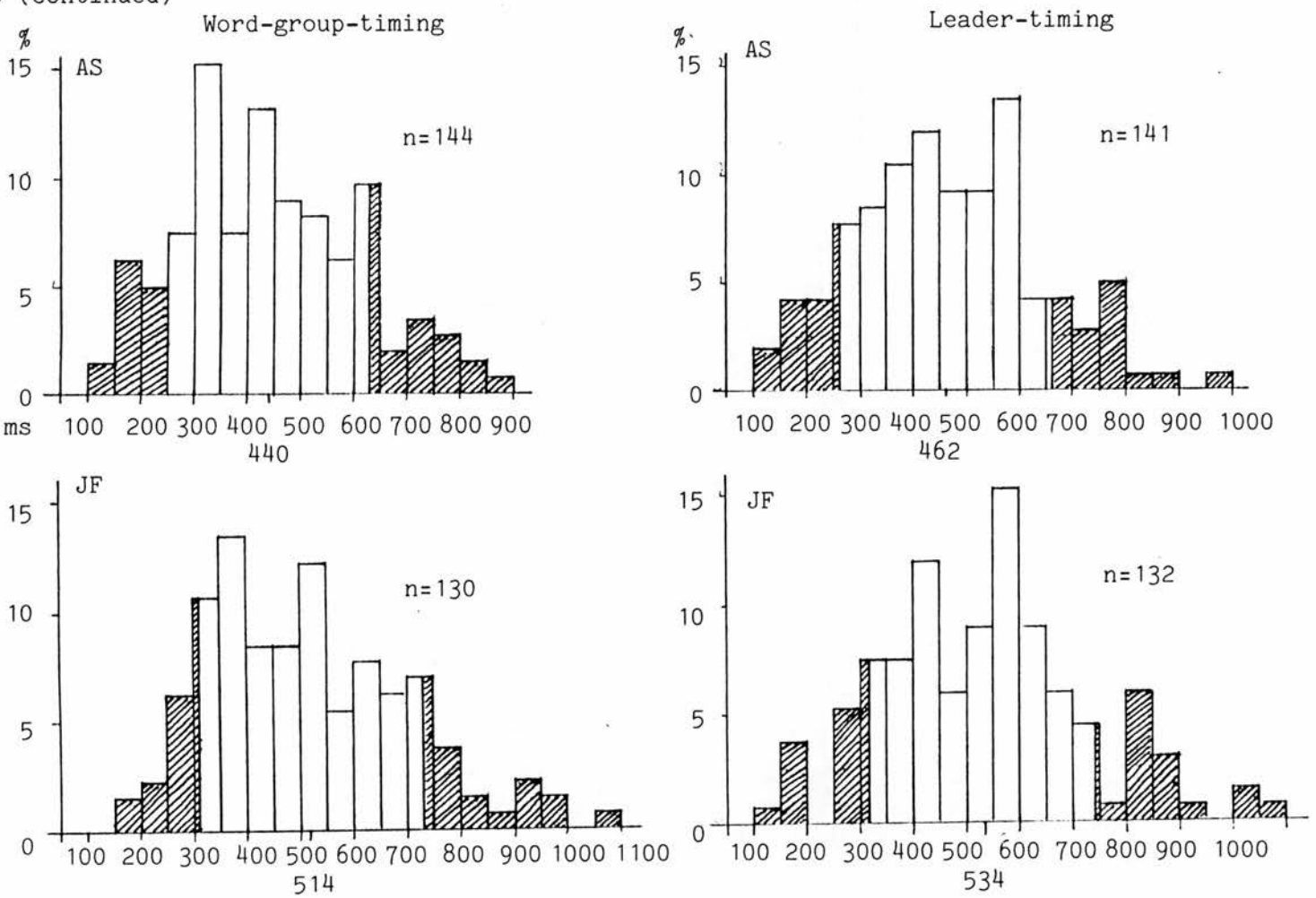


Figure 50 (continued)



Unshaded areas = 75% of range.

Although the 75% range was similar for both analyses, the whole range was greater in leader-timing than word-timing. If we look for example, at LR's figures in Table 52, the 75% range is 359 ms word-group-timing and 356 ms leader-timing, whereas the whole range is 723 ms word-group-timing, but 790 ms leader-timing.

3.1.4 Summary of Results 3.1.1 to 3.1.3

The majority of stress groups therefore have similar durations in both analyses but considering the results from Section 3.1.2, particularly comparing stressed syllable duration and Figures 46 and 47, there is more evidence to support the hypothesis that the word-timed groups function as rhythmic units rather than leader-timed. This evidence emerges mainly from the fact that the durational gap between short and long groups is narrowed in the word-timing analysis and in addition, stressed syllables of word-timed groups become significantly shorter, the more syllables there are to the group.

3.2 Syllable-timing or stress-timing

3.2.1 Interstress intervals

Variation in interstress intervals (corresponding to the leader-timed stress groups) has already been measured (cf. Table 47), and it was found that there was slightly more variation in the leader-timed groups than the word-timed but it was not significant. To compare overall variation between interstress intervals and syllables, F tests were not appropriate. Coefficients of variation were calculated and in all cases, syllables contained in interstress intervals were found to have less variation than the groups themselves. The results are presented in Table 53.

TABLE 53

Average durations, standard deviations and coefficients of variation of non-final interstress intervals and their syllables. Spanish, Noah's Ark. (ms rounded off).

Informant	Interstress intervals			Syllables		
	AD	SD	CV%	AD	SD	CV%
LR	422	154	37	146	49	33
AS	462	173	37	158	54	34
JG	431	163	38	148	46	31
JF	534	192	36	184	57	31
DP	369	136	37	129	39	30

AD = Average duration; SD = Standard deviation
CV = Coefficient of variation.

These results include all group types. Two, three and four-syllable groups, the commonest types, are also dealt with separately in Section 3.2.3. It would seem from the above table that syllables succeed each other more regularly than stressed syllables, although the majority of stressed syllables also succeed each other at regular intervals. 75% of interstress intervals fall within a narrow range which varies depending on speech rate (see Table 52).

3.2.2 Duration as a phonetic feature accompanying stressed syllables

In a strictly syllable-timed language, there should not be any difference in duration between stressed and unstressed syllables. This does not necessarily however exclude a language from being stress-timed. (If there were always the same number of unstressed syllables between stressed, a language could be both.)

All stressed and unstressed syllables of leader-timed groups were compared and the results are presented in Table 54.

TABLE 54

A comparison of stressed and unstressed syllables of leader-timed stress groups.
Spanish, Noah's Ark.

Informant	Stressed syl. AD	Unstressed syl. AD	Ratio unstr/str	Difference in ms	JND's
LR	156	138	1:1.13	18	26.4 ms
AS	179	146	1:1.23	33	27.8
JG	165	137	1:1.2	28	26.3
JF	206	171	1:1.2	35	32.2
DP	138	123	1:1.13	15	23.8

JND's = Just noticeable differences; reference duration = average duration of unstressed syllables.
These are calculated from those quoted by Lehiste (Henry 1948 in Lehiste 1970 : 12) (see Chapter IV, Table 13).

T tests applied to the data showed significant differences between all stressed and all unstressed syllables for each informant. Only three of these differences however, are above the JND's for the reference durations. Differences in average durations for LR and DP are far below their JND's. It can hardly be said therefore that an increase in duration is a clue to stress perception, as it should be common to all speakers, but rather that stressed syllables are accompanied by a slight increase in duration. The difference widens as speech tempo decreases but not exactly in proportion. I would have expected JG and DP's differences to be similar as they are both speakers of Castilian Spanish. It is clear from the above table that there are no consistent differences between stressed and unstressed syllables and although the former are longer, absolute differences seem to depend on the speech characteristics of the individual.

As unstressed syllables are generally prone to more consonantal modification than stressed, the intrinsic duration of the sounds may be

less than in the stressed syllables and this may account for the differences in duration and also the individual variation. Lehiste states that the

> "...duration of a vowel depends on the extent of the movement of the speech organs required in order to come from the vowel position to the position of the following consonant. The greater the extent of the movement, the longer the vowel" (Lehiste, 1970 : 20).

This being so, if the consonants are produced with a more open degree of stricture in unstressed syllables than stressed, the extent of tongue movement required to arrive at the position for the consonant will be lessened and vowels may therefore be shorter. The above results support the hypothesis that stressed syllables are only marginally longer than unstressed.

3.2.3 Rhythms of succession and alternation

According to the results in Section 3.2.1, syllables would appear to vary less in their duration than stress groups (Table 53). As there was little difference in variation between word-timed and leader-timed stress groups, this applies to both analyses. In that section, all group types were considered. In this section the following eight tone groups (see Note on Terminology, p. 440, for definition) have been examined in greater detail:

1. ?Porqué la ardilla tiene una cola casi tan grande como ella?
   (Why is the squirrel's tail nearly as big as herself?)
2. ?Qué hace la cochina con tantas mamas?
   (What does the sow do with so many teets?)
3. ..le deja absolutamente tranquila. (..is perfectly at ease.)
4. Y cada uno pensaba por su parte.
   (And everyone thought of his own skin.)
5. no tengo absolutamente nada que me sobre.
   (I have absolutely nothing superfluous.)
6. (no) se sabe por que conducto. (nobody knew by what means.)
7. Todo hubiera sido perfecto.
   (Everything would have been perfect.)
8. ..sin esta lluvia que no paraba jamás.
   (..without the never-ending rain.)

These tone groups were selected because they obeyed the following criteria:

1. None of the versions contained any unfilled or filled pauses.
2. All contained only two, three and four-syllable groups, whether analyzed as leader-timed or word-group-timed, with the exception of "y cada uno" N° 4, which was a very short five-syllable group. "No" in number 6 was not included as it gave rise to a one-syllable word-timed group.

The intention was to find out which units (syllables, word-timed groups or leader-timed groups) exhibit least variation within tone groups which contain typical syllable groupings. As was mentioned earlier, coefficients of variation were calculated to describe the data. The results are given in Table 55.

The following data were extracted from each tone group:

1. All syllable durations excluding those of utterance-final stressed syllables and any following unstressed, due to the possibility of pre-pausal lengthening on these syllables.
2. All word-timed group durations excluding utterance-final.
3. All leader-timed group durations excluding initial unstressed syllables and utterance-final groups.

Averaged coefficients of variation according to type of unit gave the following results for each informant, from smallest to largest:

LR : WT (21) < LT (27) < S (33)

AS : WT (22) < LT (24) < S (29)

JG : WT (23) < S (26) < LT (27)

JF : WT (26) < S (27) < LT (30)

DP : WT (24) < S (27) < LT (30)

This indicates less variation within the word-timed groups than the other units, but the only significant difference was between LR's

TABLE 55

Average durations in ms of variations of non-final syllables, word-timed groups and leader-timed groups in eight tone groups common to all informants which contain only two, three and four-syllable groups of each type of analysis. Spanish, Noah's Ark.

	Tone Group															
	1		2		3		4		5		6		7		8	
	AD	CV%	AD	CV%	AD	CV%	AD	CV%	AD	CV%	AD	CV%	AD	CV%	AD	CV%
LR, S	137	35	140	24	134	46	125	50	134	31	153	24	144	25	130	30
WT	352	39	466	15	332	25	510	9	359	30	350	16	287	9	325	27
LT	337	30	418	20	386	46	520	16	372	37	385	9	336	23	304	32
AS, S	145	29	144	28	180	29	146	31	151	27	161	39	133	33	143	18
WT	349	30	480	30	454	34	576	13	393	26	352	7	246	15	363	24
LT	326	27	445	16	470	37	522	16	420	30	422	3	310	34	351	27
JG, S	165	23	147	18	140	36	133	27	138	29	147	20	138	23	137	31
WT	392	26	488	22	352	21	532	11	361	34	364	16	258	19	344	35
LT	380	18	446	18	389	40	505	11	375	39	380	37	321	23	322	33
JF, S	190	27	172	24	177	29	164	28	160	23	201	18	179	20	169	31
WT	481	26	572	19	445	13	620	19	415	25	474	26	336	11	426	33
LT	466	30	508	12	490	38	611	20	444	36	508	24	417	26	398	31
DP, S	128	27	139	16	110	35	119	31	106	31	135	22	114	24	117	29
WT	321	35	418	33	264	30	474	16	269	35	325	17	217	2	282	25
LT	314	30	418	22	298	43	440	17	286	43	349	20	265	32	286	33

AD = Average duration; WT = Word-timed groups
CV = Coefficient of variation; S = syllable
LT = Leader-timed groups.

word-timed groups and syllables. I would have expected syllables to show less variation; however, these results are not necessarily contradictory to previous results.

Averaging all the informants' coefficients for each tone group separately, the order changes somewhat although there is still a preference for word-timed groups to be less varied:

Tone group

1 : LT (27) < S (28) < WT (31)

2 : LT (18) < S (22) < WT (24)

3 : WT (25) < S (35) < LT (41)

4 : WT (14) < LT (16) < S (33)

5 : S (28) < WT (30) < LT (37)

6 : WT (16) < LT (19) < S (25)

7 : WT (11) < S (25) < LT (28)

8 : S (28) < WT (29) < LT (31)

The range of average durations within tone groups is much greater proportionately for both types of stress groups than syllables. Table 56 shows the actual range in milliseconds of average durations and percentage increases from smallest to greatest average. For example, LR's syllables, averaged out for each tone group separately, varied from 125 ms (tone group 4) to 153 ms (tone group 6), a difference of 28 ms which corresponds to a 22% increase, taking 125 ms as the reference duration.

The syllables do not vary greatly in their average durations from tone group to tone group, whereas the word-timed groups more than double their average durations from tone group to tone group in some cases.

TABLE 56

Range of average durations of syllables, leader-timed groups and word-timed groups, showing percentage increases over the 8 tone groups examined Spanish, Noah's Ark.

Informant	between	range of	% increase	
LR	125-153	28	22	AD Syllables
AS	133-180	47	35	
JG	137-165	28	20	
JF	160-190	30	19	
DP	106-139	33	31	
LR	305-520	215	70	AD LT Groups
AS	310-522	212	68	
JG	321-505	184	57	
JF	398-611	213	54	
DP	265-440	175	66	
LR	287-510	223	77	AD WT Groups
AS	246-576	330	134	
JG	258-532	274	106	
JF	336-620	284	85	
DP	217-474	257	118	

AD = Average duration
LT = Leader-timed, WT = Word-timed.

If we compare tone groups 4 and 6, average syllable duration is shorter in 4 than 6 for all speakers, but average word-group duration is much longer. They both contain three stressed syllables but N° 4 contains 12 syllables and N° 6, only 8. The syllables in N° 4 are divided thus:

[ikaða'uno pen'saβa porsu'parte]

and in N° 6

[se'saβe por'ke kon'duɣto].

N° 4 has more syllables per word-group than N° 6, so in spite of the fact that the syllables are slightly shorter on average, the main

effect is of making the word groups longer. The leader-timed groups also vary a great deal more than the syllables over all tone groups.

There is therefore not much difference in variation between syllables and stress groups (word-timed or leader-timed) within each individual tone group, and what there is favours the word-timed groups as tending to recur more regularly than the syllables. There is however, a very apparent difference between average durations of word-timed groups (and leader-timed groups to a lesser extent) from tone group to tone group. It follows from this that the domain of regularity of recurrence of both types of stress groups (particularly word-timed) is the tone group itself.

Roach suggests that this

> "...kind of temporal regularity (referring to interstress intervals) ...is a property of a unit of speech smaller than the entire text, the tone unit.... Hence it is assumed that tempo changes will usually be manifested in terms of differences between the tempo of one tone unit and another, and will not usually be found within the tone unit"
> (Roach, 1982 : 76).

Tempo changes may of course be responsible for durations varying from tone group to tone group but in the case of the present data, there were no obvious tempo changes in any of the renderings.

Tone groups N° 4 and 7 (common to all speakers) provide the extreme word-group durations:

4. [i kaδa'uno pen'saβa por su'parte] (longest)

7. ['toδu'βjera 'siδo per'fekto] (shortest).

N° 4 contains only two stress groups of each type:

Word-timed [ikaδa'uno/pen'saβa]

Leader-timed ['unopen/'saβaporsu].

Although [ikaδa'uno] contains very short syllables on the whole, [pen] is extremely long even for a closed syllable and the extra duration is obtained in all cases, mainly by lengthening the nasal. It seems as if an attempt were being made either to separate the two stressed syllables, as the following interstress interval, due to its segmental make up, is unavoidably long, or to bring the length of [pen'saβa] closer to that of [ikaδa'uno]. The five-syllable group is shorter than average for its type and the three-syllable group considerably longer. Syllable durations differ widely within the tone group (see CV's, Table 55) but they average out to be quite normal.

The tone group with the shortest stress group averages, N° 7, is made up of three groups of each type:

Word-timed [toδu/βjera/siδo]

Leader-timed [toδu/βjera/siδoper]

One would expect the syllables to succeed each other at regular intervals in this case as each group contains two syllables in the word-timed division but in fact there is much greater syllable variation than word-timed group variation again (Table 55). [siδo] is shorter than the other two groups and [per] also shorter than the average length of syllable of this type, thus narrowing the gap between [si] and [fek], although the group [siδoper] is longer than the others. Average syllable duration for this tone group is similar to that of tone group 4.

It would seem that an attempt is made to accommodate word-timed group durations to those "prevailing" within the tone group. In N° 4, for example, the first group could hardly be shortened without affecting vowel quality, so the second is lengthened and in N° 7, [per] is shortened which has the double effect of shortening [perfekto] and narrowing the gap between the two stressed syllables.

3.3 Segment Manipulation : consonant-reducing or vowel-reducing

3.3.1 Segment manipulation within words

Section 3.3 is concerned mainly with hypothesis (g), that consonant duration varies more than vowel duration which remains constant, thus giving the impression of syllable-timing. The first part deals with compression effects within words.

The data for this section with durations of each informant is contained in Appendix 7. The groups of words examined are reproduced here for convenience and will be referred to as the "chico" series:

1. chico, chiquito, chiquitillo (small)
2. pon, ponga, pongase, pongasela (put, put it on)
3. mi (me), mito (myth), admito (I admit), readmito (I readmit)
4. vi (I saw), vino (He came), divino (divine), adivino (I guess)
5. en (in), ente (being), entero (entire), enterase (should understand)
6. mi (me), misa (mass), camisa (shirt), camiseta (vest), camisetilla (little vest)

Table 57 shows the average duration, all informants for each segment and syllable, and Figure 51 the number of segments per second according to word duration. The blank spaces in Table 57 are due to difficulty in measuring segments of some or all informants. For the graph in Figure 51, durations of complete words beginning with voiceless stops were measured from the vowel onset and the voiceless stop excluded from the number of segments in the word. In "soberano" the duration of [s] was not clear for DP and LR so this word is not included in their graphs.

It is obvious from Figure 51 that for all sets, the number of segments per second increases, the longer the word. Several general points are worth mentioning. The increase in speech rate (number of segments per second) is most noticeable between one and two-syllable words. This coincides with results of Section 3.1.1 in which

syllables of one-syllable word groups were found to be much longer than those of all other types. The set in which the number of segments per second increases most consistently for all informants is the second [pon], in which the stressed syllable is always initial. There is possibly an extra compression effect of shortening the gap between the two stressed syllables [pon] and [sjem] (of "siempre"). In all sets, although the general tendency is of an increase in segments per second as words increase in length, the difference levels out to a certain extent between words of two and four syllables and in some cases, speech rate even appears to slow up. This however is due to the fact that typically long segments have been added to the word. If we look at the graph for the [en] set for example, in which this appears to happen, the actual durations of syllables which are phonetically the same or similar (Table 57) are consistently decreasing and it is the addition of [se] which affects the timing. Even though there are two stress changes in this set, the stressed syllables ['te] and ['ra] are approximately the same duration as their unstressed counterparts in words containing one syllable less. All other things being equal, stressed syllables are longer by about 20% in Spanish than unstressed so these syllables have decreased. The actual average word durations in this set are as follows:

[en] 229 ms, [ente] 316 ms, [entero] 417 ms, [enterase] 556 ms.

Predicted average durations with no decrease would be:

[en] 229 ms, [ente] 364 ms, [entero] 497 ms, [enterase] 659 ms.

This is typical of all sets.

The informants' individual graphs are quite similar with the exception of set 3 in which they are surprisingly different. This is difficult to explain as [reaδ] was impossible to segment and the

TABLE 57

Average duration of segments and syllables in "chico" series, ms.

| | | |

Figure 51

Number of segments per second according to word duration, "chico" series.

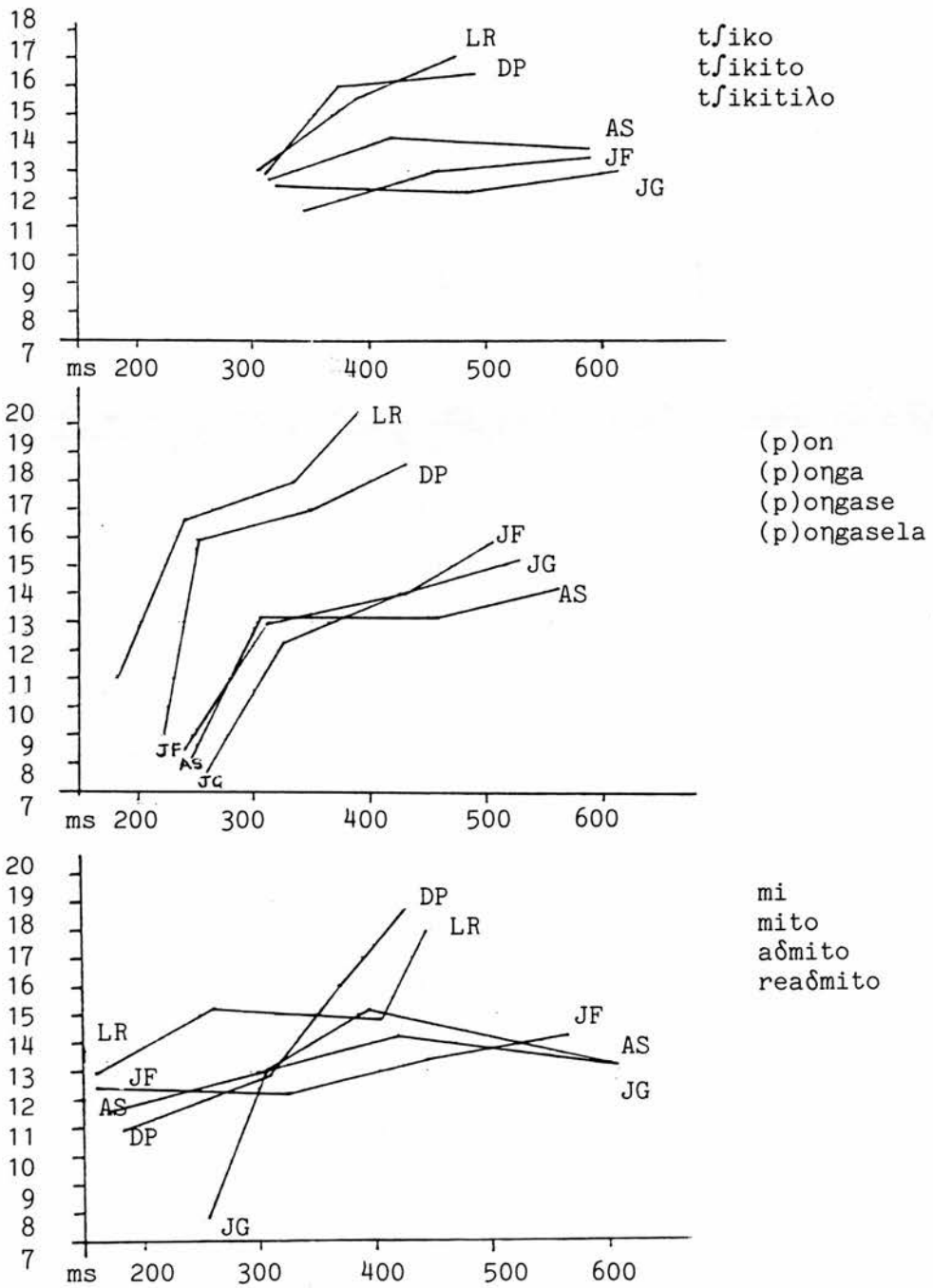


Figure 51 (continued)

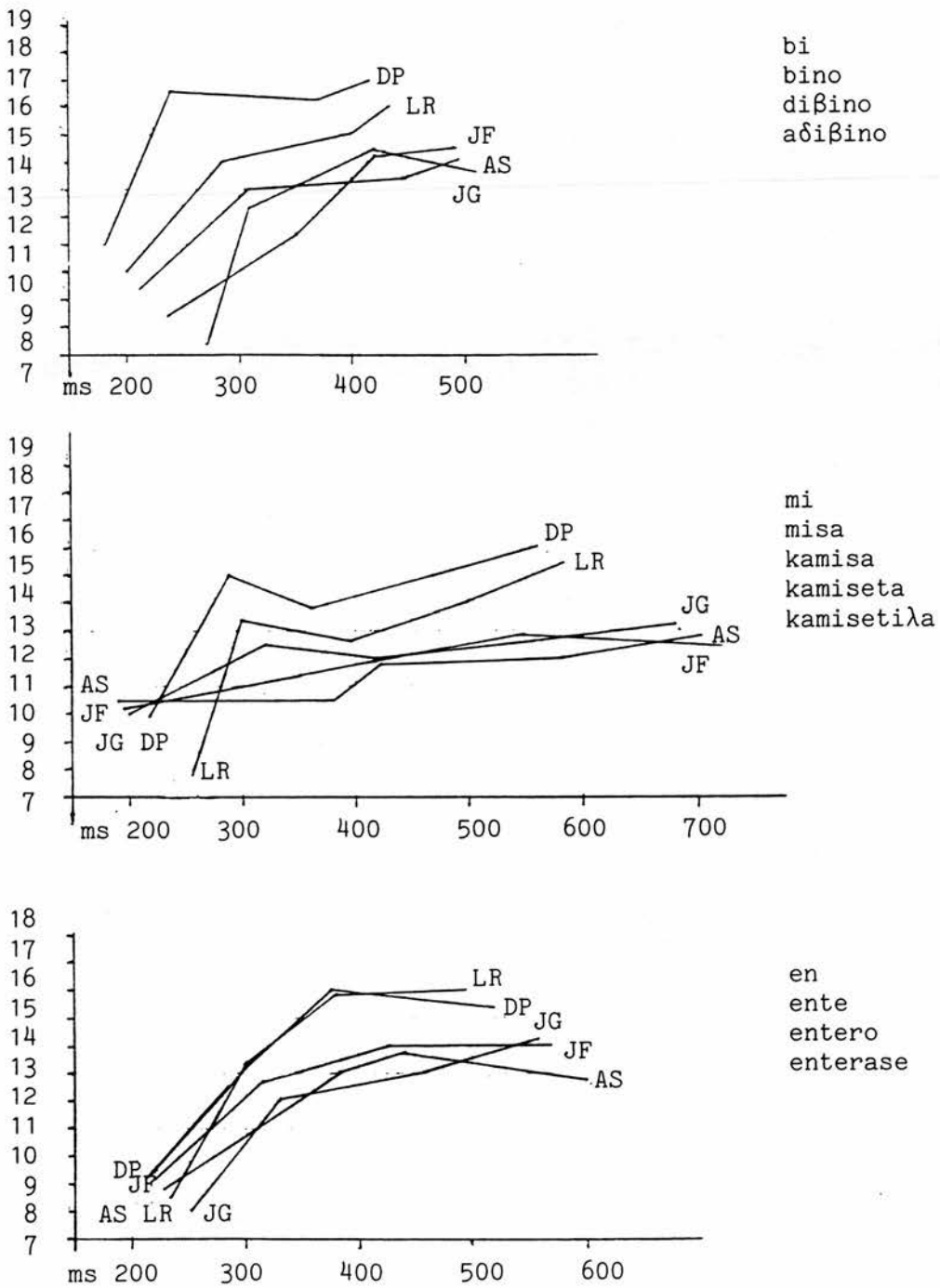
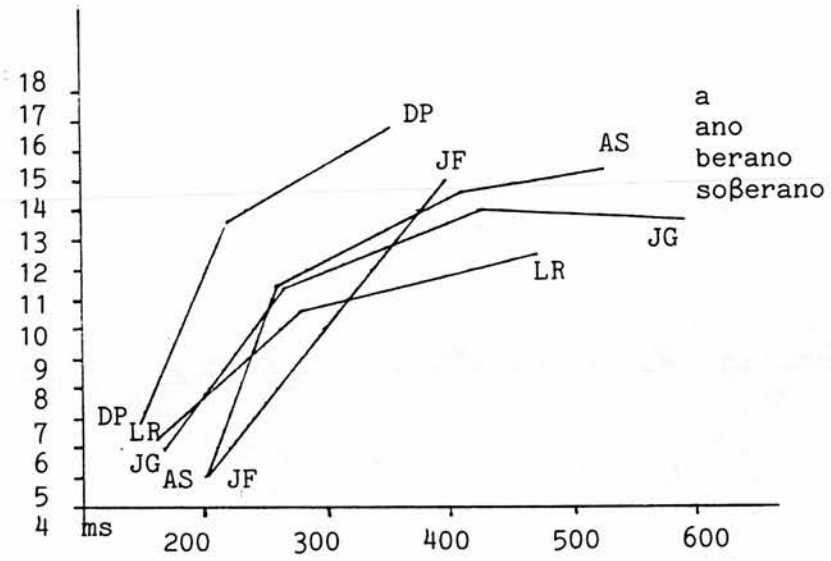


Figure 51 (continued)



differences lie mainly in the addition of [re]. The realization of the archiphoneme /R/ in this context is usually a trill but may also be a tap or fricative and may be partially devoiced. As the words were measured from the onset of voicing, differences in the realization of this phoneme may have accounted for individual differences. Apart from that, DP's and LR's graphs exhibit most similarity. AS's overall increase in segments per second is the smallest and DP's the greatest, which tallies with the results presented in Figure 46, AS's graph being closest to the predicted.

Lehiste (1970 : 40) quotes data from a study of Hungarian by Tarnoczy (1965) in which he found that word durations tend to remain relatively constant. The only figures given are for vowels however and as we shall see in the following section, both vowels and consonants are responsible for compression effects in Spanish.

3.3.2 Segment manipulation according to segment type

Table 58 contains averaged durations in milliseconds of individual segments. The overall reduction in duration is greater according to the data, for consonants than vowels. Ignoring the fact that the number of occurrences varied, the consonants decrease on average by 15.7% as words increase by one syllable, and the vowels by 10.3%. In Chapter V, Section 3.1.1.c, the results were similar where duration of stressed syllables was compared according to group type. Consonants were responsible for the decrease in duration to a greater extent than vowels.

In the present data, there is an obvious difference in duration between vowels contained in mono-syllabic words and others but if we consider those in two, three and four-syllable words (examples of the commonest types of word groups), vowel durations are remarkably

TABLE 58

Average segment reduction as number of syllables per word increases "chico" series.

Longest word of group	Segment	Number of syllables per word									Av. seg. reduction in %
		1	2		3		4		5		
		AD	AD	R	AD	R	AD	R	AD	R	
tʃikitiλo	i		98.6		71.8	27%	69.2	36%			
tʃikitiλo					107		93	13%			
reaδmito		109	94	13.8%	81	13.8%	75	7.4%			
aδiβino		142	84	40.8%	92	(9.5%)	79	14%			
aδiβino					80		95	(18.8%)			
kamisetiλa		129	98	24%	78	20.4%	69	11.5%	60	13%	12.8%
Averaged		127	94	26.2%	85	12.9%	80	10.5%	60	13%	
enterase	e	112	94	16%	62	34%	60	3.2%			
enterase			93		86	7.5%	77	10.5%			
pongasela					93		70	24.7%			
kamisetiλa							95		83	12.6%	
soβerano					80		84	(5%)			12.9%
Averaged		112	94	16%	80	20.8%	77	8.4%	83	12.6%	
soβerano	a	175	115	34.3%	102	11.3%	95	6.9%			
poŋgasela			97		86	11.3%	89	(3.5%)			
kamisa			101		98	3%					
kamisetiλa					93		90	3.2%	88	2.2%	8.6%
Averaged		175	104	34.3%	95	8.5%	91	2.2%	88	2.2%	
poŋgasela	o	126	88	30%	78	11.4%	74	5.1%			
tʃikto			114		98.8	13.3%					
reaδmito			95		102	(7.4%)	91	10.8%			
aδiβino			97		91	6.2%	92	(1%)			
soβerano			87		91	(4.6%)	86	5.5%			6.9%
Averaged		126	96.2	30%	92	3.8%	85.8	5.1%			

Table 58 (continued)

Longest word of group	Segment	Number of syllables per word									Av. seg. reduction in %
		1	2		3		4		5		
		AD	AD	R	AD	R	AD	R	AD	R	
t∫ikitiλo	∫		68.6		61.6	10.2%	54	12.3%			11.3%
poŋgasela	s				53		66	(24.5%)			
kamisetiλa			62		63	(1.6%)	70	(11%)	63	10%	(6.8%)
Averaged			62		58	(1.6%)	68	(17.8%)	63	10%	
t∫ikitiλo	k		32.2		40	(4.7%)	35	(12.5%)			3.9%
t∫ikitiλo	t				47		47	0%			
reaδmito			44		33	25%	43	(30.3%)			
enterase			42		48	(14.3%)	34	29.2%			1.9%
Averaged			43		43	5.4%	41	(0.4%)			
aδiβino	b	78	66	15.4%	40	39.4%	35	12.5%			
soβerano					51		24	60.8%			32%
Averaged		78	66	15.4%	46	39.4%	30	36.7%			
aδiβino	d				53		34	36%			36%
poŋgasela	g		18		13	28%	4	69%			48.5%
kamisetiλa	m	83	62	25.3%	72	(16%)	70	2.8%	57	18.6%	7.7%
poŋgasela	n	103	83	19.4%	78	6.0%	74	5.1%			
aδiβino			55		56	(1.8%)	55	1.8%			
enterase		117	87	25.6%	88	(1.1%)	88	0%			
soβerano			62		57	8.1%	52	8.8%			7.2%
Averaged		110	72	22.5%	70	2.8%	67	3.9%			

Av. seg. = Average segment.
AD = Average duration (all informants) ms.
R = Reduction in percentage as word increases by 1 syllable.
( ) = Increase in percentage as word increases by 1 syllable.

constant, ranging from 60 ms (unstressed /e/ and /i/ in four and five-syllable words) to 115 ms (stressed /a/ in two-syllable words). Consonant reduction is also greatest between one and two-syllable words but duration varies enormously within words of two, three and four syllables from an average of 4 ms (/g/ following nasal in four-syllable words: this figure is small due to the fact that the segment was not present in the data of four of the informants) to 88 ms (/s/).

Individual vowels do not behave very differently whereas individual consonants do. The average overall reduction for each vowel per syllable ranges from 6.9% /o/ to 12.9% /e/. (/u/ is a very infrequent vowel and is not included here but its duration is generally similar to those of /i/ and /e/.) Interestingly, reduction of the close front vowels /i/ and /e/ (whose intrinsic duration is shorter than that of /a/ and /o/) is greater than the percentage of reduction for /a/ and /o/. Navarro Tomas also found that vowels decrease as the number of sounds which follow them in the same word increase but as far as I know, did not investigate whether the number of preceding sounds had the same effect. These results are similar to his as far as open and close vowels are concerned. (see Chapter I, p.30). Consonant variation however, ranges from an addition of 6.8%, /s/, to a reduction of 48.5% /g/ (Table 58). The consonants divide themselves clearly into groups with the various realizations of voiced stop phonemes suffering the greatest modification and /s/, the least, whose duration increases on the whole as syllables are added to the words. The nasals average around 7% reduction and /t/ and /k/. 3.9% and 1.9% respectively. Giving all vowels equal weight, the percentage of reduction per vowel per syllable is as follows: between one and two-syllable words, 26.6%; two and three-syllable words, 11.5%;

three and four-syllable words, 6.6%; and four and five-syllable words, 9.3%. Overall consonant reduction is as follows: between one and two-syllable words, 21.1%; two and three-syllable words, 7.1%; three and four-syllable words, 14.4%; and four and five-syllable words, 12.9%. Compression effects in words of between three and five syllables is therefore more likely to be achieved at the expense of the consonants.

To establish accurately the percentages of vowel and consonant reduction according to word length and in all possible phonetic environments would be a thesis in itself. The purpose of this small experiment was two-fold: 1) to establish that syllables which have the same segmental components decrease in duration as the word which contains them becomes longer; 2) to show that vowel duration is more stable than consonant duration. The first point has been satisfactorily proved and the second to a certain extent. Some consonants are obviously more prone to reduction than vowels and others are not. These seem to be divided almost equally as far as relative frequency of occurrence is concerned (Chapter II, Table 3). Vowel phonemes, being fewer, occur much more frequently of course (except /u/). One should also take into account the fact that one and five-syllable words or word groups are comparatively rare so the very long vowels are also rare in continuous speech.

Although an experiment of this type has to be controlled in order to eliminate variables, the result is that actual speech is produced in artificial utterances and under artificial circumstances and I feel the results cannot be as reliable as those obtained from continuous speech, be it read or spontaneous. The many cues to meaning in speech with semantic coherence, serve to generate many redundant

features, some of which may be eliminated. In a controlled experiment, this probably does not happen, or at least happens to a lesser extent. The information quantity of vowels in Spanish is much greater than that of consonants (cf. Chapter II, Table 3). It is therefore reasonable to suppose that consonants may suffer more modification than vowels, as precise articulation, or even presence of consonants, is not always essential, their position in the context being entirely predictable. For example, the past participle morpheme of the vast majority of Spanish verbs ends in either "ido" or "ado" and [δ], the usual intervocalic realization elsewhere, is invariably omitted completely. One might argue that /o/ is also predictable, but when the past participle is used adjectivally or in the passive voice, it agrees with the noun/subject and so may be "ado, ada, ados" or "adas". As Spanish has an extremely restricted system of arresting consonants, the same occurs in syllable-final position, for example /N/ is invariably omitted in syllable-final clusters, "constancia" [kos'tanθja] (constancy), "transcribir" [traskri'βir] (transcribe).

The main relevance of these results to the rhythmic structure of Spanish consists in the following observations: 1) words are subject to compression effects as they get progressively longer but this is most noticeable between words of one and two syllables, and levels out between two, three and four-syllable words; 2) vowels, stressed and unstressed are much more stable and consistent in their durational behaviour than consonants and therefore exercise a constraint on compression. There is no great difference between individual vowels.

The durational behaviour of consonants and vowels will help to give the impression of syllable-timing in Spanish, in which vowel durations (or the voiced section of the syllable), is kept relatively constant within the most frequently occurring word groups, considering stressed mono-syllabic words as a marked case within the rhythmic organization. The longest syllable dividers are voiceless consonants, which obviously do not affect the duration of voicing, and the shortest are voiced fricatives/approximants and taps. (Nasals are somewhat longer, perhaps due to the articulatory movements involved.) In emphatic exclamations and expressions in Spanish, the consonants are audibly lengthened rather than the vowels, particularly in words of two or more syllables. In the following examples, the affected consonant is underlined:

"!E<u>s</u>o!" (Great! Well done!), "!Nu<u>n</u>ca!" (Never!), "!Adela<u>n</u>te!" (Come in!), "!Ba<u>s</u>ta!" (Enough!), "!Un cue<u>r</u>no!" (You'll be lucky!), "!A<u>j</u>o!" (exclamation of surprise, annoyance).

4. Conclusion

In general, the hypotheses outlined in the introduction to this chapter have, I feel, been proved satisfactorily, but not all to the same extent. We shall here review each one briefly.

Hypothesis

a) The fact that durations of leader-timed groups or inter-stress intervals correspond closely to the sum of average syllable durations whereas those of word-timed groups do not, shows that the domain of timing manipulation is the word-timed groups.

b) Stressed syllable duration is longer in one-syllable word-timed groups and shorter in five-syllable word-timed groups than in the other group types. This does not happen in leader-timing. Unstressed syllable duration decreases between two and five syllable groups in both analyses. Syllable duration is therefore affected to a greater extent in word-timing than leader-timing by group type.

c) The overall range of word-timed groups is less than that of leader-timed groups, so it seems that some attempt is made to bring word-timed groups within certain limits.

d) The majority of stressed syllables do occur at regular intervals but the range between the shortest and longest interstress interval for the slowest speaker is almost one second. The regularity of recurrence of stressed syllables is accounted for by the preponderance of interstress intervals containing similar numbers of syllables. Spanish can hardly be termed a stress-timed language.

e) That stressed syllables are only marginally longer than unstressed has been proved satisfactorily. Differences were even less than expected for the faster speakers.

f) The hypothesis that syllables succeed each other at regular intervals within the most common group types is doubtful. Over the whole text, syllables showed less variation than stress groups but the results of the detailed examination of the eight tone groups in Section 3.2.3 showed that stress groups (particularly word-timed) recur at more regular intervals than syllables within individual tone groups than across the whole text and there was some evidence of syllable manipulation. This suggests that

within the tone group it is word-group-timing, not syllable-timing which predominates.

g) The result of the tests for this hypothesis, that consonant duration varies more than vowel duration, seems to me to be crucial in the production and perception of Spanish rhythm. The fact that vowel duration alters comparatively little either between stressed and unstressed syllables, or from vowel to vowel, or within words of progressively increasing length is, I think, the most important factor in the perception of Spanish as syllable-timed.

To sum up, syllable duration within word-timed groups may be affected, particularly that of stressed syllables, if the groups are very short or very long. Whether this is an unconscious attempt on the part of the speaker to lessen the gap between stressed syllables or to bring word (or word-group) durations closer to some preconceived average, is impossible to tell, but the data examined in this chapter suggest the latter. The all-important constraint on any manipulation of timing is one on vowel duration which due to the importance of vowels for comprehension, cannot be allowed to fall below a certain level at which recognition would be impaired.

CHAPTER VII

CONCLUSIONS

1. Summary of Results

The results of the experiments have been summarized at the ends of their respective chapters, but are reproduced here for convenience.

The two perceptual experiments contained in Chapter III showed that listeners are able to distinguish stressed syllables from unstressed by the glottal signal only, recorded on a laryngograph, and are able to identify different languages (English, French and Spanish) by the same signal. Utterances were chosen in which it is hoped that intonation was eliminated as a variable. Successful identification rate was approximately 65%, but French and Spanish were confused to a much greater extent than English and French or Spanish and English. It was concluded that the rhythm of Spanish is closer to that of French than English.

As stress is an essential part of rhythm in Spanish, Chapter IV investigated the phonetic features which accompany stressed syllables in Spanish. The following four features were found to be prominent: (a) differentiating pitch movement, DPM; (b) steady state of intensity of stressed vowel compared to unstressed; (c) extra duration on stressed vowel (but slightly shorter releasing consonant); and (d) weak voicing of releasing "voiceless" consonant of unstressed syllable, and slight aspiration following release of voiceless stop to stressed vowel. It was found that none of these features are essential but at least one is always present. As different intonation contours were used, it was apparent that DPM's are only present if they are permitted by the intonation. Duration is a complex correlate, manifesting itself mainly on word-final syllables. Penultimate syllables, stressed or unstressed, are nearly equal in length. The extra duration on stressed syllables does not exceed the

JND's for all speakers (calculated from their reference durations).

English and French are heard as having very different rhythms and have been classified as stress-timed and syllable-timed respectively. From previous studies (some of which are mentioned in Chapter I), it has been established that stressed syllables in French are much longer, when compared to unstressed, than those in English. The results of Chapter IV show that there is even less difference in duration between stressed and unstressed syllables in Spanish and yet the results of Chapter III imply that the rhythm of Spanish is closer to that of French than English. There appear to be two conclusions contradicting previous ideas: French is not objectively syllable-timed, and durational relationships in Spanish seem to be closer to those of English.

In Chapter V, features responsible for rhythmic differences between the languages were investigated. The results show that syllable structure and the relatively regular recurrence of unstressed syllables in French are responsible for the impression of syllable-timing but the terms leader-timing and trailer-timing are preferred to differentiate the rhythms of English and French respectively. Spanish was found indeed to have more features in common with French than English, but not of a durational nature. Several important features of Spanish differed from the other two languages: (a) the domain of any manipulation of syllable duration is the word-timed group; (b) syllable duration (stressed and unstressed) is more equal; (c) consonants are modified in Spanish to a much greater extent; (d) all vowels are peripheral; (e) the majority of syllables are of a simple structure; and (f) there is virtually no difference in distribution of syllable structure between stressed and unstressed syllables.

The above features were attributable to Spanish when comparing it to English and French. For Chapter VI, I extracted three possible rhythmic categories from the results of Chapter V and examined the features attributed to Spanish under the appropriate category headings, using five native informants. The three categories were the following:

1. Word-group-timing, leader-timing or trailer-timing?
2. Syllable-timing or stress-timing?
3. Consonant-reducing or vowel-reducing?

All informants' results showed there was less variation between the word groups than between groups of other types but the result was not statistically significant. Syllables were found to exhibit less variation than stress groups of any sort when considering the whole passage, but when individual tone groups were examined, word-groups were found to be isochronous and stress-timed groups also showed less variation than syllables.

Differences in syllable duration are particularly noticeable in comparing words of one stressed syllable with words of more than one. The vowel is responsible for the increase in duration. These syllables are very infrequent however. In words and word-groups of two, three and four syllables, which are the commonest types, within-speaker vowel duration changes very little. When syllables were added progressively to words, the number of segments per second increased as the words became longer. Between words of three and five syllables, the shortening of consonants was mainly responsible for the increase in speech rate. Between words of one and three syllables, it was the shortening of vowels.

I consider therefore that Spanish can be termed syllable-timed. Vowels tend to have equal durations everywhere, average stressed and unstressed syllables are not necessarily differentiated by perceptible duration and, over a long passage, syllables show less variation than groups of syllables. There are however constraints. In extremely long words or word groups, duration will be attenuated and speech rate increased or decreased accordingly. When speech rate increases, certain consonants are likely to suffer modification and may disappear altogether. This process is resisted by vowels.

From the results of Chapter V, the rhythmic structures of the three languages can be classified according to the above-mentioned categories:

English : Leader-timed, stress-timed, vowel-reducing.

French : Trailer-timed.

Spanish : Word-group-timed, consonant-reducing.
Syllable-timed (subordinate to word-group-timing).

English has been placed into three categories which are all compatible, French into only one, the implications of which are defined by Wenk (see Chapter I, p.27), and Spanish into three, word-group-timing and consonant-reducing which are compatible, and syllable-timing which will be maintained as long as the word groups are not of extreme durations which force a manipulation of syllable durations.

2. Suggestions for further research

The thesis has touched on many points which would have been fascinating to pursue but would have detracted from the main topic. Spanish phonetics needs to be further investigated, particularly the realizations of the voiced oral stop consonants in connected speech, which were found not to correspond to traditional phonological rules.

Another aspect which merits further study is sinalefa. Does it occur consistently between speakers in the same phonetic context? Is it dependent on speech rate, syntactic or semantic units, or all three? What are the resulting vowel qualities from the various possible combinations? Do resulting durations fit in with the rhythmic structure? This has been touched on by several authors but not to any great depth.

A thorough investigation of stress correlates in Spanish would obviously be a thesis in itself. As mentioned in Chapter IV, carefully controlled perceptual experiments would need to be carried out using at least all the parameters I have dealt with, as variables. Berinstein's work is extremely useful, but deals only with duration and position within groups of four syllables. The role of fundamental frequency and steady state intensity would be particularly interesting to follow up.

Chapter V compared the rhythmic features of English, French and Spanish. It would be interesting to compare more languages in this way and find out whether groups of languages have certain features in common. As far as I know, no other language modifies its consonants to the same extent as Spanish but it would be worthwhile looking at languages whose vowel systems are simple and non-predictable (in Spanish, all vowels can occur in any position, although /u/ is infrequent word-finally), but whose consonant systems are large and more restricted as to position within the structure.

The extent to which consonants are reduced in Spanish could also be studied in greater detail. More experiments of the type described in Chapter VI ("chico" series) could be carried out, designed to control each individual segment, and subjects could be asked to use different

speech rates.

The above are just a few of the possible areas of further investigation which have arisen from this thesis.

3. Applications

The possible applications of a study of this type are several, the most obvious one being the construction of an exercise typology based on the results, to teach rhythmic features to second language learners. If the students were native speakers of English learning Spanish, the following general types of exercises should be worked through, in both production and perception:

1. Vowels, in short phrases, using minimal pairs differentiated by unstressed vowels, e.g. "duermen/duerman".
2. Consonants and clusters in short phrases, differentiated by reduced consonants, e.g. "la boda/la boba".
3. Word-groups of increasing complexity using minimal stress pairs and typical rhythmic groupings, e.g. "la toco/la tocó", "que límite/que limite".
4. Different combinations of word groups.
5. Different intonation contours using sentences of the same segmental structure to force use of different stress correlates.

Individual segmental problems should be pointed out and dealt with as they crop up. As performance in the rhythm of the target language becomes more efficient, many problems take care of themselves, e.g. diphthongization of /e/ and /o/.

Other possible areas in which a study of this type could be useful might include speech synthesis and speech recognition, in which

timing relationships play a crucial part.

The elusive syllable, with its structure, its combinatory possibilities, its increasing or decreasing, is the basic unit upon which the rhythmic structure of languages is built. Anyone who has measured thousands, as I have done, must surely feel like one of William Cowper's philologists:

> "Philologists who chase
> A panting syllable through time and space,
> Start it at home, and hunt it in the dark,
> To Gaul, to Greece, and into Noah's Ark."
>
> (Cowper, Retirement).

APPENDIX 1

NOAH'S ARK : ORTHOGRAPHY

1. English

The lion, who had had no trouble in getting everyone together, took the floor, "My friends, let us look to ourselves for examples and try to keep calm. What does the lizard do in a fight? He gives up his tail to conserve the greater part of his strength. A wonderful lesson! Aren't there many of us who have vulnerable parts which are not of vital importance to us? Why is the squirrel's tail nearly as big as himself and follows him round like a curse? What does the sow do with so many teats? Is she quite sure that she hasn't twice as many as she really needs?"

"She's absolutely sure," said the sow.

"Let her examine her conscience!"

"Her conscience is perfectly at ease."

"We shall see about that," replied the lion, very sure of himself.

And everyone thought of his own skin.

"As for me, I have nothing superfluous. I need everything that belongs to me."

"Couldn't we find amongst some of our beloved brethren," continued the lion, "one or two pounds of meat which they could afford to do without?"

"And what about you, why have you got such a big head?" suddenly asked an enormous bear who had kept quiet up till then.

"I really need it to have enough room to think about each one of you," replied the lion. "But in order to show you my willingness to sacrifice something, I put my royal mane at the disposal of all of you, big and small."

This was greeted with a loud burst of laughter which made the lion feel very uncomfortable.

"I'm very upset," he said, hardly able to hold back the tears which had managed to reach him somehow from the nearby crocodile.

But his words were interrupted by the cheers which greeted the angels and their baskets of food. Yes, everything would have been fine if it hadn't been for the never-ending rain. Not a single dry moment throughout the whole day.

2. French

Le lion, qui n'eut pas de peine à rassembler tout le monde, prit la parole, "Mes amis, sachons tirer des examples de nous-mêmes et garder notre sang-froid. Que fait le lézard dans la bataille? Il abandonne sa queue pour sauver le gros de ses forces. Grande leçon! N'y en a-t-il pas beaucoup parmi nous dont le corps offre des parties condamnées d'avance parce qu'elles n'ont pas pour eux un intérêt vital? Pourquoi l'écureuil a-t-il un queue presque aussi grosse que lui et qui le suit comme un reproche? Que fait la truie de tant de mamelles? Est-elle bien sûre de ne pas en avoir une bonne moitié de trop?"

"Elle en est parfaitement sûre," dit la truie de sa place.

"Qu'elle interroge sa conscience!"

"Sa conscience la laisse parfaitement en repos."

"C'est ce que nous verrons," dit le lion, très maître de lui.

Et chacun songeait à part soi.

"Moi, je n'ai absolument rien de trop. Je tiens à tout ce qui me concerne."

"Nous trouverions aussi chez certains d'entre nos frères bien-aimés," poursuivit le lion, "une ou deux livres de viandes qui ne leur sont pas indispensables."

"Et toi, pourquoi as-tu la tête si grosse?" dit brusquement un ours énorme qui avait gardé le silence jusqu'alors.

"It faut bien que j'aie assez de place pour penser à chacun de vous," riposta le lion. "Mais voulant vous montrer mon esprit de sacrifice, je mets à la disposition de tous, grands et petits, en commençant par les petits, ma royale crinière."

Ce fut un large éclat de rire qui laissa le lion déconfit.

"Vous me faites beaucoup de peine," reprit-il, retenant mal des larmes qui lui venaient on ne sait par quel canal de son voisin le crocodile.

Mais son discours fut interrompu par les hourras qui acceuillirent les anges et leurs paniers de provisions. Oui, tout serait allé pour le mieux sans cette pluie qui ne cessait point. Pas une seconde de sèche pendant les vingt quatre heures de la journée.

3. Spanish

El león, que no tuvo ningún trabajo en reunir a todo el mundo, tomó la palabra, "Amigos míos, saquemos ejemplo de nosotros mismos y conservemos nuestra sangre fría. ?Qué hace el lagarto cuando pelea? Pierde la cola para salvar el grueso de sus fuerzas. !Gran lección! ?No tenemos muchos de nosotros partes del cuerpo que puedan ser sacrificadas primero porque no tienen un vital interés para nosotros? ?Porqué la ardilla tiene una cola casi tan grande como ella y que le sigue como un castigo? ?Que hace la cochina con tantas mamas? ?Está muy segura que no le sobra por lo menos la mitad?"

"Perfectamente segura," dijo la cochina.

"Que le pregunte a su conciencia!"

"Su conciencia le deja absolutamente tranquila".

"Eso lo veremos," dijo el león, segurisimo de simismo.

Y cada uno pensaba por su parte.

"Pues yo no tengo absolutamente nada que me sobre. Yo necesito todo lo que tengo."

"Podríamos encontrar también entre algunos de nosotros, queridos hermanos," continuó el leon, "una o dos libras de carne que no nos son indispensables".

"Y tú ?porqué tienes la cabeza tan grande?" dijo bruscamente un oso enorme que había estado callado hasta entonces.

"Es muy necesario que yo tenga bastante espacio para pensar en cada uno de vosotros," contestó el león. "Pero para demostraros mi espíritu de sacrificio, yo pongo a disposición de todos, grandes y chicos, empezando par los chicos, mi real melena."

Hubo una explosión de risas que dejó al leon desconcertado.

"Me haceis mucho daño," dijo, reprimiendo con dificultad las lágrimas que le venían, no se sabe por qué conducto, de su vecino el cocodrilo.

Pero su discurso fue interrumpido por los 'hurras' a los ángeles y sus cestas de provisiones. Sí, todo hubiera sido perfecto sin esta lluvia que no paraba jamás. Ni un segundo seco en las veinticuatro horas del día.

APPENDIX 2

The thirty sentences used for language identification from laryngographic recordings in Experiment 1, Chapter III.

1. Et toi, pourquoi tu as la tête si grosse? dit brusquement un ours énorme qui avait gardé le silence jusqu'alors.

2. I really need it to have enough room to think about each one of you, replied the lion.

3. The lion, who had had no trouble in getting everyone together, took the floor.

4. Sí, todo hubiera sido perfecto sin esta lluvia que no paraba jamás.

5. Perfectamente segura, dijo la cochina.

6. Ni un segundo seco en la veinticuatro horas del día.

7. Mais voulant vous montrer mon esprit de sacrifice, je mets à la disposition de tous, grands et petits, en commençant par les petits, ma royale crinière.

8. The lion, who had had no trouble in getting everyone together, took the floor.

9. And everyone thought of his own skin.

10. Yes, everything would have been fine it it hadn't been for the never-ending rain.

11. Pourquoi l'écureuila-t-il un queue presqu'aussi grosse que lui et qui le suit comme un reproche?

12. Le lion, que n'eut pas de peine à rassembler tout le monde, prit la parole.

13. Why is the squirrel's tail nearly as big as himself and follows him round like a curse?

14. Oui, tout serait allé pour le mieux sans cette pluie qui ne cessait point.

15. Pero su discurso fue interrumpido por los hurras a los ángeles y sus cestas de provisiones.

16. Y cada uno pensaba por su parte.

17. Not a single dry moment throughout the whole day.

18. Elle en est parfaitement sûr, dit la truie de sa place.

19. Su conciencia la deja absolutamente tranquila.

20. Not a single dry moment throughout the whole day.

21. Porqué la ardilla tiene una cola casi tan grande como ella y que le sigue como un castigo.

22. Pas une seconde de sèche pendant les vingt-quatre heures de la journée.

23. Y tú, porqué tienes la cabeza tan grande dijo bruscamente un oso enorme que había estado callado hasta entonces.

24. Why is the squirrel's tail nearly as big as himself and follows him round like a curse?

25. Sí, todo hubiera sido perfecto sin esta lluvia que no paraba jamás.

26. Sa conscience la laisse parfaitement en repos.

27. And what about you? Why have you got such a big head? suddenly asked an enormous bear who had kept quiet up till then.

28. Oui, tout serait allé pour le mieux sans cete pluie que ne cessait point.

29. Pourquoi l'écureuil a-t-il un queue presqu'aussi grosse que lui et le suit comme un reproche.

30. Ni un segundo seco en las veinticuatro horas del día.

APPENDIX 3

Data for Papa/papá experiment, Chapter IV

Speaker JG, Castillian

Stressed syllables /'papa/(odds), /pa'pa/(evens)

A		B	C	D	E	F	G	H	I	J	K	L	M
1		1	128	52	76	0.25	10	140	210	+ 70	48	48	0
		2	143	46	97	0	0	125	175	+ 50	45	40	- 5
		3	150	53	97	0	10	160	150	- 10	46	40	- 6
	final	4	247	33	214	0	0	150	100	- 50	43	0	-43
2		5	177	74	103	0.25	8	120	100	- 20	43	30	- 7
	final	6	260	35	225	0.50	0	150	100	- 50	40	0	-40
		7	153	68	85	0.25	0	150	140	- 10	47	48	+ 1
		8	132	37	95	0.10	0	100	110	+ 10	45	47	+ 2
		9	151	38	113	0.50	6	150	190	+ 40	48	45	- 3
		10	157	27	130	0.10	0	100	150	+ 50	49	30	19
3		11	152	70	82	0	5	100	200	+100	49	49	0
		12	141	40	101	0.10	12	100	150	+ 50	45	42	- 3
		13	180	73	107	0.50	0	200	100	-100	40	10	-30
	final	14	250	50	200	0	0	100	100	0	38	0	-38
4		15	120	32	88	0.75	0	150	250	+100	46	38	- 8
		16	150	58	92	0.80	0	100	200	+100	45	40	- 5
		17	137	55	82	0	8	100	100	0	43	44	+ 1
		18	152	42	110	0	0	100	100	0	35	44	+ 9
5		19	180	60	120	0.10	0	150	150	0	45	45	0
		20	164	38	126	0.10	10	100	200	+100	44	43	- 1
		21	150	48	102	0	4	125	150	+ 25	46	45	- 1
		22	140	38	102	0.25	3	125	150	+ 25	47	44	- 3
6		23	150	38	112	0.10	0	95	100	+ 5	37	37	0
	final	24	240	36	204	0	0	100	100	0	42	0	-42
		25	131	40	91	0.10	0	125	125	0	45	45	0
		26	128	21	107	0.10	9	125	120	- 5	42	43	+ 1

Key

final = Utterance-final
A = Tone group
B = Number of utterance
C = Syllable duration, ms.
D = C duration, ms.
E = V duration, ms.
F = Voicing of [p] 0-1
G = Aspiration, ms.
H = Fo Start Hz(V)
I = Fo Finish Hz(V)
J = Difference Fo (DPM)
K = dB start (V)
L = dB finish (V)
M = dB difference.

Speaker JG, Castillian

Unstressed syllables /'papa/(odds),/pa'pa/(evens)

A		B	C	D	E	F	G	H	I	J	K	L	M
1		1	128	66	62	0.80	0	200	200	0	47	42	- 5
		2	130	48	82	0.40	0	110	125	+ 15	47	35	-12
	final	3	210	65	145	0	6	100	80	- 20	30	10	-20
		4	153	56	97	0.15	0	160	150	- 10	45	35	-10
2	final	5	216	60	156	0.10	0	100	90	- 10	35	0	-35
		6	133	53	80	0.50	0	160	150	- 10	45	35	-10
		7	110	36	74	1.00	0	150	140	- 10	46	35	-11
		8	120	39	81	0.50	0	150	100	- 50	45	45	0
		9	121	37	84	0.40	0	190	150	- 40	45	30	-15
		10	124	33	91	0.80	0	150	145	- 5	47	35	- 8
3		11	130	67	63	0.90	0	200	200	0	43	40	- 3
		12	132	50	82	0	0	100	100	0	47	45	- 2
	final	13	190	50	140	0	10	100	150	- 50	40	0	-40
		14	141	60	81	0.30	0	200	100	-100	43	33	-10
4		15	121	47	74	0.40	0	250	200	- 50	43	35	- 8
		16	123	55	68	0.70	5	150	150	0	46	42	- 4
		17	93	42	51	0.30	0	100	100	0	38	10	-28
		18	140	53	87	0	0	100	100	0	40	30	-10
5		19	140	40	100	0.90	0	150	200	+ 50	46	40	- 6
		20	146	48	98	0	0	110	100	- 10	44	30	-14
		21	100	39	61	0.90	0	150	150	0	46	42	- 4
		22	127	38	89	0	0	125	125	0	44	35	- 9
6	final	23	240	51	189	0.10	0	100	100	0	40	0	-40
		24	130	33	97	0.90	0	100	100	0	37	30	- 7
		25	119	22	97	0.90	0	125	125	0	43	43	0
		26	132	30	102	0	0	120	125	+ 5	42	43	+ 1

Speaker LR, Andalusian

Stressed syllables /'papa/(odds), /pa'pa/(evens)

A		B	C	D	E	F	G	H	I	J	K	L	M
1		1	191	86	105	0	3	100	150	+50	45	45	0
		2	131	52	79	0.70	0	100	120	+20	43	42	- 1
		3	165	57	108	0	0	100	90	-10	40	10	-30
	final	4	137	45	92	0	0	90	100	+10	42	20	-22
2		5	165	50	115	0.10	0	100	100	0	40	35	- 5
	final	6	171	27	144	0	18	90	90	0	35	0	-35
		7	122	50	72	0.10	0	120	120	0	45	45	0
		8	145	53	92	0.50	0	100	100	0	41	37	- 4
		9	160	60	100	0.40	0	100	120	+20	45	45	0
		10	200	42	158	0.10	7	90	110	+20	44	32	-12
3		11	95	32	63	0.10	0	95	105	+10	20	40	+20
		12	114	33	81	0.10	12	100	140	+40	43	43	0
		13	170	51	119	0	10	130	140	+10	43	43	0
	final	14	158	28	130	0.30	0	140	160	+20	40	40	0
4		15	140	56	84	0.30	0	130	80	-50	42	42	0
		16	153	40	113	0.10	0	130	100	-30	45	30	-15
		17	124	51	73	0	8	100	110	+10	44	44	0
		18	145	44	101	0.10	0	90	140	+50	43	44	+ 1
5		19	182	57	125	0.20	5	180	180	0	45	47	+ 2
		20	186	35	151	0.15	0	120	150	+30	40	40	0
		21	99	29	70	0.20	0	80	100	+20	47	47	0
		22	103	35	68	0	12	80	120	+40	42	37	- 5
6		23	158	48	110	0.10	0	100	110	+10	43	45	+ 2
	final	24	156	45	111	0.10	0	110	170	+60	43	30	-13
		25	137	59	78	0.05	0	100	120	+20	43	44	+ 1
		26	125	50	75	0.10	8	100	100	0	40	40	0

Speaker LR Andalusian

Unstressed syllables /'papa/(odds),/pa'pa/(evens)

A		B	C	D	E	F	G	H	I	J	K	L	M
1		1	120	50	70	0.80	0	150	150	0	45	45	0
		2	119	45	74	1.00	0	90	90	0	40	30	-10
	final	3	115	77	38	0	0	90	50	-40	31	0	-31
		4	153	65	88	0.05	0	90	90	0	42	20	-22
2	final	5	131	81	50	0	0	100	50	-50	20	0	-20
		6	145	57	88	0.10	0	100	90	-10	42	25	-17
		7	108	40	68	0.90	0	100	100	0	42	42	0
		8	125	54	71	0	5	105	100	- 5	42	30	-12
		9	150	40	110	1.00	0	125	125	0	44	30	-14
		10	170	80	90	0.05	0	95	90	- 5	40	40	0
3		11	92	23	69	1.00	0	100	175	+75	40	45	+ 5
		12	130	53	77	0	0	100	100	0	41	30	- 9
	final	13	138	37	101	0.10	0	140	175	+35	42	0	-42
		14	130	49	81	0.25	0	120	120	0	45	30	-15
4		15	120	49	71	1.00	0	90	100	+10	41	40	- 1
		16	170	79	91	0.10	0	150	140	-10	45	30	-15
		17	114	44	70	0.90	0	100	120	+20	44	44	0
		18	160	73	87	0.05	10	90	90	0	35	41	+ 6
5		19	148	33	115	1.00	0	180	150	-30	45	42	- 3
		20	152	55	97	0.40	0	135	125	-10	41	30	-11
		21	123	51	72	0.90	0	80	160	+80	47	35	-12
		22	134	80	54	0	0	80	80	0	35	25	-10
6	final	23	163	72	91	0.05	8	110	150	+40	41	0	-41
		24	144	53	91	1	0	100	100	0	43	30	-13
		25	101	39	62	0.80	0	120	115	- 5	42	42	0
		26	101	51	50	0.20	0	105	100	- 5	40	42	+ 2

Speaker AS Venezuelan

Stressed syllables /'papa/(odds), /pa'pa/(evens)

A		B	C	D	E	F	G	H	I	J	K	L	M
1		1	153	53	100	0.20	7	220	250	+ 30	47	48	+ 1
		2	144	40	104	0.20	0	220	220	0	42	35	- 7
		3	225	71	154	0	0	250	200	- 50	43	25	-18
	final	4	223	90	133	0	0	250	175	+ 25	41	20	-21
2		5	200	55	145	0	0	275	300	+ 25	40	30	-10
	final	6	204	60	144	0	0	250	240	- 10	45	0	-45
		7	188	85	103	0	0	230	250	+ 20	46	46	0
		8	178	78	100	0.05	0	250	250	0	45	46	+ 1
		9	200	98	102	0.10	0	200	260	+ 10	47	47	0
		10	182	66	116	0	0	200	250	+ 50	45	40	- 5
3		11	162	70	92	0.40	3	150	250	+100	45	45	0
		12	176	60	116	0.5	4	250	250	0	45	35	-10
		13	220	68	152	0	0	270	220	- 50	45	43	- 2
	final	14	255	91	164	0	0	250	200	- 50	33	33	0
4		15	210	78	132	0	0	250	350	+100	45	43	- 2
		16	185	51	134	0	0	200	350	+150	45	35	-10
		17	154	58	96	0.05	0	200	250	+ 50	44	44	0
		18	188	72	116	0	0	270	330	+ 60	44	44	0
5		19	227	92	135	0	3	325	340	+ 15	45	44	- 1
		20	180	60	120	0.10	5	250	325	+ 75	43	42	- 1
		21	135	54	81	0.05	10	250	250	0	20	44	+24
		22	187	62	125	0	10	200	300	+100	45	40	- 5
6		23	235	72	163	0	0	250	250	0	41	41	0
	final	24	273	73	200	0	0	200	225	+ 25	41	30	- 9
		25	200	76	124	0.05	0	250	250	0	42	42	0
		26	230	47	183	0	8	250	250	0	43	40	- 3

Speaker AS Venezuelan

Unstressed syllables /'papa/(odds),/pa'pa/(evens)

A	B	C	D	E	F	G	H	I	J	K	L	M
1	1	154	75	79	0.50	0	250	275	+ 25	43	40	- 3
	2	142	40	102	0.40	0	210	220	+ 10	45	32	-13
final	3	155	72	83	0	0				30	0	0
	4	142	50	92	0.25	0	200	225	+ 25	44	35	- 9
2 final	5	190	82	108	0	0				20	0	-20
	6	176	58	118	0.05	10	240	250	+ 10	44	25	-19
	7	152	64	88	0.40	0	250	250	0	44	30	-14
	8	142	50	92	0.15	0	200	250	+ 50	45	35	-10
	9	165	74	91	0.50	0	260	250	- 10	45	35	-10
	10	170	54	116	0.40	0	200	225	+ 25	44	30	-14
3	11	120	50	70	0.30	0	200	300	+100	44	35	- 9
	12	187	65	122	0.20	0	250	250	0	45	25	-20
final	13	190	78	112	0	0	200	300	+100	44	0	-44
	14	150	60	90	0.05	0	200	250	+ 50	35	20	-15
4	15	181	55	126	0	0	400	350	- 50	43	10	-33
	16	170	51	119	0	0	250	250	0	45	20	-25
	17	143	60	83	0.75	0	250	340	+ 90	44	44	0
	18	220	100	120	0	0	350	350	0	40	25	-15
5 final	19	262	95	167	0	7	350	360	+ 10	43	0	-43
	20	184	58	126	0	0	300	300	0	44	20	-22
	21	119	34	85	1	0	250	300	+ 50	44	36	- 8
	22	185	65	120	0.20	0	200	250	+ 50	44	10	-34
6 final	23	225	88	137	0	0	250	250	0	40	0	-40
	24	180	50	130	0.05	0	250	225	- 25	40	25	-15
	25	200	50	150	0.50	0	225	225	0	41	25	-16
	26	190	35	155	0	0	250	250	0	43	20	-23

Speaker JF Mexican

Stressed syllables /'papa/(odds),/pa'pa/(evens)

A		B	C	D	E	F	G	H	I	J	K	L	M
1		1	190	92	98	0	12	100	100	0	38	37	- 1
		2	212	87	125	0	0	90	100	+10	39	35	- 4
		3	203	96	107	0	0	90	85	- 5	40	39	- 1
	final	4	235	50	185	0	0	95	90	- 5	35	0	-35
2		5	162	58	104	0	0	90	90	0	38	38	0
	final	6	270	81	189	0	0	90	90	0	38	0	-38
		7	111	41	70	0.05	0	100	100	0	42	43	+ 1
		8	176	83	93	0	10	100	100	0	43	42	- 1
		9	198	104	94	0	10	115	125	+10	44	30	-14
		10	244	106	138	0	0	90	110	+20	42	42	0
3		11	137	58	79	0	0	90	100	+10	44	45	+ 3
		12	165	72	93	0	0	90	100	+10	45	45	0
		13	180	69	111	0	5	100	100	0	49	49	0
	final	14	252	80	172	0	10	90	120	+30	42	25	-17
4		15	190	91	99	0	0	150	125	-25	44	44	0
		16	176	73	103	0	0	100	125	+25	38	45	+ 7
		17	143	45	98	0	0	90	120	+30	46	48	+ 2
		18	150	55	95	0	0	95	100	+ 5	47	46	- 1
5		19	185	70	115	0.05	0	150	150	0	49	49	0
	final	20	322	86	236	0	0	110	150	+40	48	43	- 5
		21	149	56	93	0	0	100	175	+75	47	47	0
		22	165	60	105	0	0	100	125	+25	45	46	+ 1
6		23	194	64	130	0	0	90	100	+10	45	45	0
	final	24	314	71	243	0.05	0	90	100	+10	40	44	+ 4
		25	113	20	93	0.80	0	100	90	-10	46	46	0
		26	148	36	112	0.10	0	150	100	-50	45	48	+ 3

Speaker JF Mexican

Unstressed syllables /'papa/(odds),/pa'pa/(evens)

A		B	C	D	E	F	G	H	I	J	K	L	M
1		1	130	49	81	0.05	5	100	120	+20	41	30	- 9
		2	128	50	78	0	0	90	90	0	37	37	0
	final	3	255	96	159	0	20	85	85	0	35	0	-35
		4	160	89	81	0	0	100	95	- 5	33	10	-23
2	final	5	215	79	136	0	0	90	100	+10	41	0	-41
		6	130	57	73	0	0	90	90	0	37	37	0
		7	102	29	73	0.80	0	100	100	0	43	42	- 1
		8	159	83	76	0.10	0	100	100	0	43	43	0
		9	147	61	86	0.10	0	115	115	0	43	30	- 7
		10	159	92	67	0.05	0	100	100	0	44	34	-10
3		11	122	59	63	0.10	0	100	140	+40	46	40	- 6
		12	135	53	82	0	0	90	90	0	43	30	- 7
	final	13	236	80	156	0.10	0	100	150	+50	47	35	-12
		14	160	79	81	0.30	0	100	90	-10	45	30	-15
4		15	129	50	79	0.25	0	150	125	-25	42	35	- 7
		16	169	81	88	0	0	100	100	0	45	30	-15
		17	150	65	85	0.20	0	100	100	0	47	45	- 2
		18	143	55	88	0.40	0	95	95	0	47	30	-17
5	final	19	212	84	128	0.30	0	150	160	+10	48	20	-28
		20	191	86	105	0.60	0	150	100	-50	48	48	0
		21	129	59	70	0.25	0	150	90	-60	47	46	- 1
		22	173	65	108	0	0	100	100	0	45	45	0
6	final	23	293	87	206	0.10	0	100	140	+40	45	0	-45
		24	167	57	110	0.30	0	110	100	-10	45	30	-15
		25	117	24	93	0.80	0	90	90	0	47	49	+ 2
		26	133	34	99	0.90	0	150	150	0	48	25	-23

APPENDIX 4

Phonetic symbols used in text and appendices

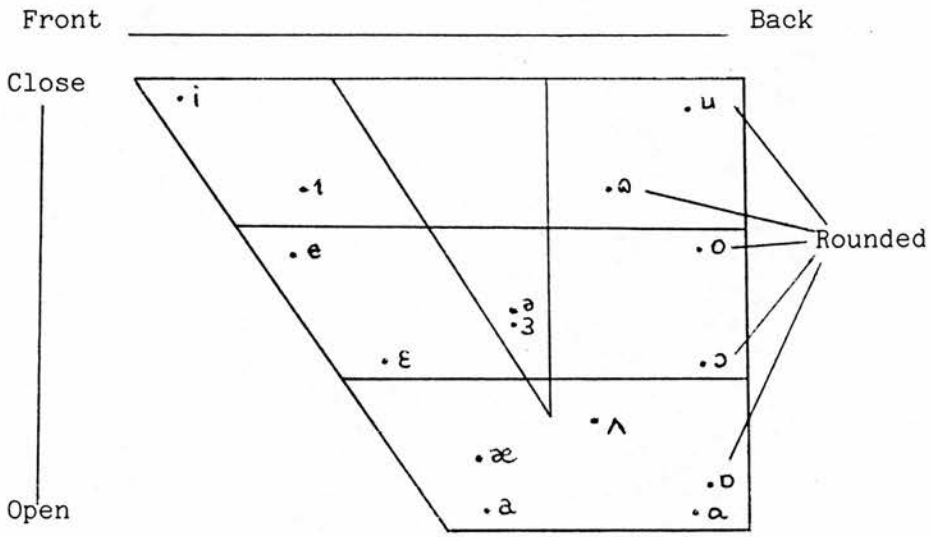
Consonants

Text	Appendices	Description
p	p	Voiceless labial stop
b	b	Voiced labial stop
m	m	Labial nasal
β	β	Voiced labial fricative or approximant
f	f	Voiceless labio-dental fricative
v	v	Voiced labio-dental fricative
t	t	Voiceless alveolar stop (English), dental (French and Spanish)
d	d	Voiced alveolar stop (English), dental French and Spanish)
θ	θ	Voiceless dental fricative
ð	ð	Voiced dental fricative
s	s	Voiceless alveolar fricative (English and French) apico-postalveolar (Spanish)
z	z	Voiced alveolar fricative
r	r	Postalveolar approximant (English)
r	r	Voiced alveolar tap (Spanish)
rr	rr	Voiced alveolar trill (Spanish)
n	n	Alveolar nasal
l	l	Alveolar lateral approximant
ʃ	ʃ	Voiceless palato-alveolar fricative
ʒ	ʒ	Voiced palato-alveolar fricative
tʃ	tʃ	Voiceless palato-alveolar affricate
dʒ	dʒ	Voiced palato-alveolar affricate
j	j	Palatal approximant
ɲ	ɲ	Palatal nasal
ʎ	ʎ	Palatal lateral approximant
k	k	Voiceless velar stop
g	g	Voiced velar stop
x	x	Voiceless velar fricative
ɣ	ɣ	Voiced velar fricative
R	ʁ	Voiced uvular fricative or approximant
ŋ	ŋ	Velar nasal
h	h	Voiceless glottal fricative
ɦ	ɦ	Voiced glottal fricative
ʔ	ʔ	Glottal stop
w	w	Labial-velar approximant
ɥ	ɥ	Labial-palatal approximant.

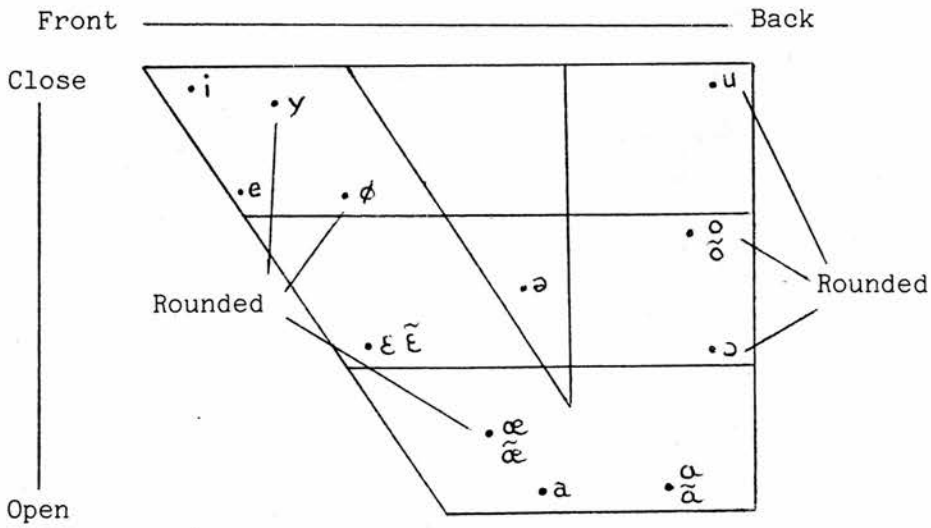
Vowel symbols (approximate positions)

Combinations of the symbols are used for diphthongs

English

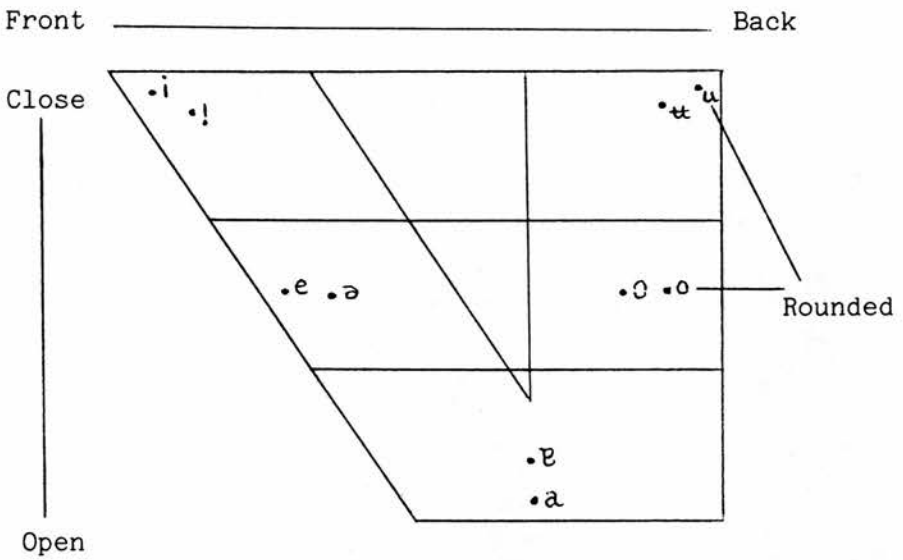


French



Text	Appendices	
∂	ə	Central vowel (schwa)
α	ɑ	Open back unrounded vowel.

Spanish



Diacritics used

ˈ	Stressed syllable
^	Pause
n̩	Syllabic consonant
t͡ʍ	Lip-rounding
tʲ	Palatalization
tʰ	Aspiration on release of stop
ã	Nasal vowel (French)
ã	Nasalized vowel (English and Spanish)
ᵊ	Spanish : short non-syllabic central vowel
d̥	Devoiced segment
(t)	Presence of segment uncertain
¦	Imprecise segmentation
e̞	Open variety (Spanish)
u̯	Semi-vowel (Spanish)
a̰	Velarized (Spanish).

APPENDIX 5

Noah's Ark data used for experiment in Chapter V

APPENDIX 5

Texts Examined

English Noah's Ark

Orthographic text		The		lion,		who					
Phonetic transcription		ʌ	ðə	ˈl	aɪ	ə	n	ʌ	h		
Length in msecs	Segment			50	220	40	212		94		
	Syllable		50	270		252					
	Stress group (N°) + pauses	(1)	50	(2)	522			185			

had had no trouble in

ɑ	ə	d	ˈh	æ	ð	n	oʊ	ˈt	r	ʌ	β	ɻ	ɪ	ŋ
100			48	129	42	72	114	112	97		55	47	60	75
194	43		219			186		209			102		135	
(3)	237		(4)	405				(5)					720	

getting everyone together,

g	ɛ	t	ɪ	ŋ	ˈɛ	v	r	ɪ	w	ʌ	n	t	ə
34	71	80	50	39	83	28	28	77	36	77	53	50	70
105		169			111		105		166			120	
					(6)		502						

took the floor. "My

ˈg	ɛ	ð	ə	ˈt	ɑ	ʔ	ðˤ	ˈf	l	ɔ	ʌ	m	aɪ
29	128	37	200	147	88	40	81	99	89	186			
157		237		275			81	374				145	
(7)	394			(8)	356			(9)	374		1028	(10)	145

friends, let us look

ˈf	r	ɛ	n	z̪	ʌ	l	ɛ	t	ʌ	s	ˈl	ʊ	k
70	366			101		42	58	29	86	83	37	107	39
537						129			169		183		
(11)	537				365	(12)	298				(13)	422	

to ourselves for examples,

t	ʊ	ɑə	ˈs	ɛ	l	v	z̪	f	ə	ɪ	ɣ	ˈz	ɑ	m
39	59	141	110	145	150			110	65	65	44	51	150	51
98		141	405					175		109		252		
			(14)	687								(15)	594	

and try to keep

p	l	z̪	ʌ	ə	n	ˈt	ɻ	aɪ	t	ə	k	i	p
58	284					121	154	44	56	87	112	41	
342				84		275		100		240			
			158	(16)	84	(17)	615						

calm. What does the lizard

ˈk	ɑ	m	ʌ	ˈw	ɒ	ð	ə	z	ð	ə	ˈl	ɪ	z̊	
100	230	130				45	82	40	41	44	55	90	50	
460				107		167			85		145			
(18) 460			685	(19)		359					(20)			

do in a fight? He gives

ə	d̥	ˈd̥	u	ɪ	n	ə	ˈf	aɪ	t	ʌ	ɪ	ˈg	ɪ	v
120	35	35	120			76	99	214	122		100	41	101	72
205		155		100		76	435				100	215		
350		(21)		331			(22) 435			709	(23) 100	(24)		

up his tail to conserve

z	ʌ	p	ɪ	z̊	ˈt	eɪ	l	t	ə	k	ˈn	ˈs	ɜ	v
	100	75	84	52	94	169	96	55	70	60	132	88	149	33
	175		136		359			125		192		270		
526					(25)			676				(26)		387

the greater part of his

ð	ə	ˈg̊	r	eɪ	t	ə	ˈp	ɑ	t	ə	v̊	ɪ	z̊	
38	79	52	133		36	48	123	131	39	67	61	77	55	
117		185			84		293			128		132		
		(27)	269				(28)			607				

strength. A wonderful

ˈs	t	r	ɛ	ŋ	θ	ʌ	ə	ˈw	ʌ	n	ð	ə	f	l̥
47	65	229					71	40	70	48	111		75	87
341							71	158			111		162	
(29)	341					656	(30) 71	(31)	431					

lesson! Aren't there many of

ˈl	ɛ	s	n	ʌ	ˈɑ	n	ð	ə	ˈm	ɛ	n	ɪ	ə	v
79	92	114	162		102		76	70	90	64	93	49	49	57
171		276			102		146		154		142		106	
(32)	447			932	(33)	248			(34)	406				

us who have vulnerable

ˈʌ	s	h	u	f	ə	v̊	ˈv̊	ʌ	l	n	r̥	β	l	
161	129	50	100	137		40	40	155		47	37	52	94	
290		150		177			195			84		146		
(35)			617				(36)		425					

parts which are not of vital

ˈp	ɑ	t	s	w	ɪ	tʃ	ə	ˈn	ɒ	t	ə	v̊	ˈv̊	aɪ
120	176	79	141	93		75	54	78	78	64	103	27	26	149
516				168			54	220			130		175	
(38)			738					(38)	350				(39)	

importance to us?

t	l	ɪ	m	ˈp	ɔ	t	n	s	t	ɑ	ˈʌ	s	^
66	76	101		62	125	55	117	85	73	107	68	155	
142		101		187		257			180		223		
418				(40)		624					(41)	223	

Why is the squirrel's tail

ˈw	aɪ	ɪ	z	ð	ə	ˈs	k	w	ɪ	r	l	z	ˈt	eɪ
164		86	27	27	64	94	62	102		127		66	114	372
164		113		91		258				193			486	
(42)		368				(43)		451					(44)	486

nearly as big as himself

l	ˈn	ɪə	l	ɪə	z	ˈb	ɪ	ɣ	ə	z	h	ɪ	m	
						59	113		72	58	50	44	77	
						172			130		171			
	(45)	344				(46)	473							

and follows him round

ˈs	ɛ	l	f	n	ˈf	ɒ	l	oʊ	z	ɪ	m	ˈr	aʊ	n
103	122	52	187	111	107	50	55	109	108	65	73	217		76
464				111	157		272			138		293		
(47)	575				(48)	567						(49)		

like a curse? What does the

l	aɪ	k	ə	ˈk	ɜ	s	^	ˈw	ɒ(ʔ)	d	ʌ	z	ð	ə
40	102	49	48	117	214	269		156		49	81	32	30	78
191			48	540				156		162			108	
532				(50)	540		805	(51)		426				

sow do with so many tits?

ˈs	aʊ	ˈd	u	w	ɪ	θ	ˈs	oʊ	m	ɛ	n	ɪ	ˈt	ɪ
112	224	40	160	116		57	50	310					116	176
336		200		173									495	
(52)	336	(53)		373			(54)	360					(55)	495

Is she quite sure that

t	s	^	ɹ	ʃ	ʃ	ɹ	ˈk	w	aɪ	ʔ	ˈʃ	ɷə	ð	ə
65	138		51	62	63	62	110	173		54	111	224	89	
			113		125		337				335		89	
		722	(56)		238		(57)	337			(58)		578	

she hasn't twice as many

ʃ	ɹ	ˈh	a	z	n	ˈt	w	aɪ	s	ə	z	ˈm	ɛ	n
82	72	129		38	123	91	153		48	74	46	77	70	60
154		129		290		292				120		147		
		(59)		419		(60)		412				(61)		527

as she really needs?"

ɪ	ə	ʃ	ʃ	ɪ	ˈr	ɪə	l	ɪ	ˈn	i	d̥	z̥	^
70	50	62	53	95	148		62		315		173		
130		102		148	148		62		315		173		
					(62)	210			(63)	488			802

"She's absolutely sure",

ʃ	ɪ	z	ˈa	β	s	ə	l	ɑ	ð̞	l	ɪ	ˈʃ	ɑə	
88	92	60	80	57	85	55	43	76	31	33	77	103	248	
240			137		140		150			110		351		
(64) 240			(65)		537							(66)		

said the sow. "Let her examine

s	e	d	ð̞	ə	ˈs	əʊ	^	ˈl	ɛ	t	ɜ(r)	ɪ	ɣ	ˈz	ə
94	100	32	25	38	107	270		54	111	84	124	65	71	65	91
226			63		377			249			124	136		156	
640					(67) 377		637	(68)		509				(69)	

her conscience!" "Her

m	ɪ	n	ɦ	ɜ	ˈk	ɒ	n	ʃ	ə	ɳ	s	^	ɜ
101		34	54	126	97	153		80	175		140		95
135			180		250			395					95
471					(70)		645					659	95 (71)

conscience is perfectly

ˈk	ɒ	n	ʃ	ə	n	s	ɪ	z	ˈp	ɜ	f	ɪ	k	t
90	70	85	65	60	60	20	88	32	90	110	60	100	32	33
245			205				120		200		225			
(72)			570						(73)		584			

at ease. "We shall see

l	ɪ	ə	ð̞	ˈi	z̥	^	w	ɪ	ʃ	l	ˈs	i	ə
70		89		359			153		70	96	105	116	70
70		89		359			153		166		221		70
				(74) 359		807	(75)	319			(76)		521

about that", replied the

b	əʊ	ʔ	ˈð̞	ə	ʔ	r	ɪ	ˈp	l	əɪ	d	ð̞	ə
50	143	37	40	132	52	134		83	190		69	110	
230			224			134		342				110	
			(77)		358			(78)		452			

lion, very sure of himself

ˈl	əɪ	ə	n	ɣ	ɛ	r	ɪ	ˈʃ	ɔ	r	ə	v	h	ɪ
200		130		50	68	110		124	118		83	47	58	134
200		130		118		110		242			130		192	
(79)			558					(80)		564				

And everyone

m	'ɛ	v	r	ɪ	w	ʌ	n	
	60	25	92	25	84	76		
	85		92	185				
	(83)		362					

'ɛ	v	r	ɪ	w	ʌ	n	n	'ɛ	v	r	ɪ	w	ʌ	n	
88	180						111	60	25	92		25	84	76	
268							111	85		92		185			
(81) 268							1197	111 (82)	(83)		362				

thought of their own skin.

'θ	ɔ	t	ə	v	ɪ	z	'oʊ	n	's	k	ɪ	n	ʌ
87	138	45	62	45	75	48	140	90	90	54	268		
270			107		123		230		412				
(84)			500				(85) 230		(86) 412				1328

"As for me, I have nothing

'a	z	f	ə	'm	i	ʌ	ʔ	aɪ	h	a	v	'n	ʌ
135	73	45	57	201	190		40	111	107		26	144	
208		102		391			151		133			144	
(87) 310				(88) 391		232	(89)		284			(90)	

superfluous. I need

θ	ɪ	ŋ	s	ʊ	'p	ɜ	f	l	ʊə	s	ʌ	aɪ	n	i
60	60	66	64	108	80	154	80	168		142		143	43	102
186			172		234		390					143	170	
502					(91)		624				460	(92)	313	

everything that belongs

ð	'ɛ	v	r	ɪ	θ	ɪ	ŋ	ð	b	ɪ	'l	ɒ	ŋ	z
25	100	37	42	91	75	200		45	45	40	50	100	80	70
	137		133		275			45	85		300			
	(93)				675						(94)		487	

to me." "Couldn't we find

t	ə	'm	i	ʌ	'k	ʊ	ð	n	w	ɪ	'f	aɪ	n	ð
87	100	260		1608	65	125			113		85	120	79	
187		260				125			113		284			
		(95) 260		(96)							(97)			612

amongst some of our beloved

ə	m	ʌ	ŋ	's	ʌ	m	v	'aə	b	ɪ	'l	ʌ	v	ɪ
87	25	88	128	140	71	100	74	190	65		65	80	55	54
87	231			311			74	190	65		145		169	
				(98)		385		(99)	255		(100)		314	

brethren", continued

ð	b	r	ɛ	ð	r	ə	n	k	ŋ	't	ɪ	n	j	ʊ
60	66	28	114	70	106		121	90	125	52	128		88	
	280				227			215		180			115	
	(101)				722					(102)		378		

the lion", one or two

d	ð	ə	'l	aɪ	ə	n	ʌ	'w	ʌ	n	ɔ	ɾ	u
27	28	55	210		152			33	75	62	110	100	131
	83		210		152			170			110	231	
			(103)		362		400	(104)			511		

pounds of meat which they

'p	aʊ	n	z	ə	v	'm	i	ʔ	ʌ	w	ɪ	tʃ	'ð	eɪ
120	250		41	106		103	177	90		108		90	134	
411				106		370				198			134	
(105)		517				(106)	370		81	(107)	198		(108)	

could afford to do without?"

k	ə	ð	ə	'f	ɔ	d	t	ə	'd	u	w	ɪ	'ð	aʊ
66	72		84	94	165	30	29	56	47	143	47		36	210
138			84	289			85		190		47		334	
356				(109)		374			(110)	237			(111)	

"And what about you? Why

t	ʌ	n	'w	ɒ	ð	ə	b	aʊ	ð	'j	u	ʌ	'w	aɪ
88		154	66			86	44	246		385			200	
		154	66			86	290			385			200	
334	1036	154	(113)			442				(114)	385	145	(115)	

have you got such a big

ə	v	'j	u	g	ɒ	ʔ	's	ʌ	tʃ	ə	b	ɪ	g
110	40	35	150	35	70	38	97	70	55	70	47	108	28
150		185		143			222			70	183		
350		(116)		328			(117)			475			

head?" suddenly asked an

'h	ɛ	d	ʌ	's	ʌ	ð	n	l	ɪ	'a	s	t	ə	n
72	215	75		110	112	108		127		160	55	60	43	49
360				222		108		127		275			92	
(118)	360		228	(119)		457				(120)			420	

enormous bear who had kept

t	'n	ɔ	m	ə	s	'b	ɛə	h	ʊə	d	'k	ɛ	p
53	109	118	120		78	80	305	95	138	42	90	110	70
53	227		198			385		275			270		
	(121)		425			(122)		660			(123)	270	

quiet up till then. "I

'k	w	aɪ	ə	t	ʌ	ʔ	t	ɪ	l	'ð	ɛ	n	ʌ	aɪ
100	130		54	56	80	62	68	65	58	51	94	162		160
230			110		142		191			307				160
(124)					673					(125)	307		2110	160

really need it to have

ˈr	iə	l	ɪ	ˈn	i	ð	ɪ	t	t	ə	ˈh	a	v	ɪ
160		85		90	135		122	38	52	85	118		35	60
160		85		225			160		137		153			60
(127)	245			(128)		522					(129)			495

enough room to think about

n	ʌ	f	ˈr	u	m	t	ə	ˈθ	ɪ	ŋ	k	ə	b	aʊ
70	90	62	220	98	48	67	78	137		32	55	45	165	
282			318		115		247				55		243	
			(130)	433			(131)	545						

each one of you", replied

t	ˈi	tʃ	w	ʌ	n	ə	v	ˈj	u	ʌ	r	ɪ	ˈp	l
33	138	112	188		77			339			122		69	
	250		188		77			339			122			
	(132)		515					(133)	339	63	(134)	122	(135)	

the lion. "But in order

aɪ	d	ð	ə	ˈl	aɪ	ə	n	ʌ	ˈb	ʌ	t	ɪ	n	ˈɔ
203	24	24	70	52	210	160			97	195	139	66	47	141
296		94		262		160			431			113		141
390				(136)	422			616	(137)	544				(138)

to show you my willingness

ð	ə	t	ə	ˈʃ	oʊ	j	ə	m	aɪ	ˈw	ɪ	l	ɪ	ŋ
79		55	57	98	251	101		136		160		48	62	62
79		112		349		101		136		160		172		
332				(139)		586				(140)				

to sacrifice something

n	ə	s	t	ə	ˈs	a	k	r	ɪ	f	aɪ	s	ˈs	ʌ
80	82	111	73	66	85	121	56	69		69	155	57	57	61
273			139		206		125			281				211
690					(141)		612						(142)	

I put my royal

m	θ	ɪ	ŋ	ʌ	aɪ	p	oʊ	ð	m	aɪ	ˈr	ɒɪ	ə	l
93	80	92	126		140	78	70	30	207		235			
	298				140		178		207		235			
509				514	(143)			525			(144)	235		

mane at the disposal

ˈm	eɪ	n	ə	ð	ð	ə	d	ɪ	s	ˈp	oʊ	z	l	
432			36	37	37	58	32	74	76	58	204	48	80	
432			73		95		182			262		128		
(145)			782							(146)		545		

of all of you, big and small".

ə	ʌ	ˈɔ	l	ə	ʌ	j	ɑʊ	ˈb	ɪ	ɡ̊	ə	n	ˈs	m
100	55	135	78	75	40	293		128	99	26	47	112	106	92
155		213		115		229		253			159			
		(147)		621				(148)		412			(149)	

This was greeted

ɔ	l	ʌ	ˈʒ	ɪ	s	w	ə	z̥	ˈɡ̊	r	i	t	ɪ	ð
122	136		31	62	89	90		60	58	179		54	88	26
456			182			150			237			168		
456		1160	(150)		332				(151)					593

with a loud burst of laughter

w	ɪ	ð̊	ə	ˈl	aʊ	d̥	ˈb̥	ɜ	s	t	ə	ʌ	ˈl	a
26	52	41	69	78	260	32	32	182	54	49	61	45	61	173
119			69	370			317				106		321	
				(152) 370			(153)		423				(154)	

which made the lion

f	t	ə	ʌ	w	ɪ	tʃ	m	eɪ	d̥	ɣ̊	ə	ˈl	aɪ	ə	n
87	37	185		90		92	95	111	30	30	44	58	140	45	95
	222			182			236			74		198		140	
543			102	(155)			310					(156)			

feel very uncomfortable.

f	i	l	ˈv	ɛ	r	ɪ	ʌ	ŋ	ˈk	ʌ	m	f	t	ə
80	212		40	136	132		135		54	72	50	60	59	81
292			176		132		135		236				140	
630			(157)		443				(158)			591		

"I'm very upset", he

b̥	l	ʌ	aɪ	m	ˈv	ɛ	r	ɪ	ʌ	p	ˈs	ɛ	t	ɪ
32	183		124	88	38	128	64		123	37	113	147	62	103
215			212		166		64		160		322			103
		1093	(159)212		(160)		390				(161)		425	

said, hardly able to

ˈs	ɛ	d̥	(ɹ)	ˈh	a	d̥	l	ɪ	ˈeɪ	β	l̩	t	ə	
95	192	226		144	38	55	55		180	119		61	65	
453						110			180	119		126		
(162)			(163)						(164)		425			

hold back the tears which

ˈh	oʊ	l	ˈb	a	ʔ	ð̊	ə	ˈt	ɪə	z	ʌ	w	ɪ	tʃ
59	116	88	34	96	44	63	77	106	199	197		94		56
263			174			140		422				150		
(165) 263			(166)	312				(167) 422			328	(168)		250

had managed to reach him

ə	ð	ˈm	a	n	ɪ	dʒ	t	ə	ˈr	i	tʃ	ɪ	m	
70	30	95	73	87	47	86	61	60	49	132	112	53	77	
100		168		220			121		293			130		
		(169)		509					(170)		423			

somehow from the nearby

ˈs	ʌ	m	h	aʊ	f	r	ə	m	ð	ə	ˈn	ɪə	b	aɪ
80	58	82	58	197	87	40		120	38	40	57	141	54	232
220			255		247				78		198		286	
(171)			800								(172)	484		

crocodile. But his

ˈk	ɾ	ɒ	k	ə	d	aɪ	l	ʌ	b	ə	t	ɪ	z	
125		75	65	88					60	80	34	112	42	
200			153		343				174			154		
(173)			696					909	(174)		328			

words were interrupted

ˈw	ɜ	d	z	w	ə	r	ɪ	n	t	ə	ˈr	ʌ	β	t
332			64	136			128		60	62	120		74	55
396				136			128		122		194			
(175)				660							(176)			

by the cheers which greeted

ɪ	d	b	aɪ	ð	ə	ˈtʃ	ɪə	z	w	ɪ	tʃ	ˈg	ɾi	t	ɪ
168		35	143	30	77	133	284	51	118		60	72	145	59	90
223		178		107		468			178			217		159	
702						(177)		646				(178)			

the angels and their baskets

ð	ð	ɪ	ˈeɪ	n	dʒ	(ə)l	z	ʌ	ə	n	ð	ɜ	ˈb	a
10	10	70	257		36	197	123		144		95		52	169
	80		257		356				144		95			293
456			(179)		613			75	(180)		239		(181)	

of food. Yes,

s	k	ɪ	t	s	ə	v	ˈf	u	d	ʌ	ˈj	ɛ	s	ʌ
72	52	86	30	52	92	44	91	296			62	136	176	
	220				136		387				374			
649							(182) 387			804	(183) 374			114

everything would have been

ˈʔ	ɛ	v	ɾ	ɪ	θ	ɪ	ŋ	ə	d	ə	v	b	ɪ	n
52	98	38	35	82	100	60	155	95	53	72	20	35	67	88
188			117		315			148		92		190		
(184)						1050								

fine if it hadn't been

ˈf	aɪ	n	ʌ	ɪ	f	ɪ	ʔ	ˈh	a	ð	n	β	ɪ	n
100	181	184		73	41	74	30	49	53	150		98		102
465				114		104		102		150		200		
(185) 465			305	(186) 218				(187) 672						

for the never-ending

f	ə	ð	ə	ˈn	ɛ	v	ə	r	ɛ	n	ð	ɪ	ŋ	
85	55	38	42	90	75	50	90		81	104	179			
140		80		165		140			185		179			
				(188) 669										

rain. Not a single dry

ˈr	eɪ	n	ʌ	n	ɒ	ð	ə	ˈs	ɪ	ŋ	ɣ	l̥	d̥	r
210		169		109		109		106	69	77	20	148	65	
379				109		109		252			168			
(189) 379			842	(190) 218				(191) 420					(192)	

moment throughout the whole

aɪ	ˈm	oʊ	m	ə	n(ʰ)	θ	r	ʊ	aʊ	ʔ	ð	ə	ˈh	oʊ
177	108	107	81	132		88	82		112	62	88		33	128
242	215		213			170			174		88		271	
242	(193) 772												(194) 271	

day.

l	ˈd	eɪ
110	310	
	310	
	310	

Aspiration following voiceless stops is included in the value for the stop.

( ) Brackets enclose short segment which may or may not be present.

ˌ Indicates devoiced or partially devoiced segment.

ˈ Stress marker.

ð Used for voiced interdental fricative or approximant and voiced alveolar fricative or approximant.

! Segmentation uncertain.

French Noah's Ark

Trailer-timed analysis

Orthography	Le lion, qui n'eut															
Transcription	l	a	'l	j	õ	k	i	n	ø							
Segment duration, ms	75	135	180		180	98	36									
Syllable duration, ms	210		360			134		91								
Stress group N° ( ) Stress group & pause duration, ms	(1)		570			(2)		393								

pas de peine à rassembler

'p	a	d	ə	'p	ɛ	n	ə	ʁ	a	s	ɑ̃	'b	l	e
87	81	47	70	140	104	43	95			126	137	25	35	80
168		117		287			95	110		263		140		
		(3)		404			(4)		608					

tout le monde, prit la parole:

t	u	l	'm	õ	d	'p	ʳʁ	i	l	a	p	a	'k	ɔ
150	85	60	85	210	120	189	50	34			104	72	111	104
295			415			273			57		176		333	
(5)		710				(6) 273			(7)		566			

"Mes amis, sachons tirer

l	^	m	e	z	z	a	'm	i	s	a	'ʃ	õ	t	i
118		94		24	24	83	69	101	88	55	109	108	97	65
		118			107		170		143		217		162	
	1526	(8)			395				(9)	360			(10)	

des exemples de

ʁ	e	d	e	z	z	ɛ	g	'z	ɑ̃	p	l	ə	ð	a
33	76	54	85	30	30	70	60	49	176	55	80		62	65
164		169			160			225		135			127	
880										(11)			876	

nous-mêmes et garder notre

n	u	'm	ɛ	m	e	'g	a	ʁ	d	e	n	ɔ	t	ʁ
97	158				60	55	53	60	64	60	59	63	118	48
255		350			60	168			124		122		166	
					(12)	228			(13)				622	

sang-froid. Que fait le lézard

's	ɑ̃	'f	ʁ	w	a	^	k	ə	f	ɛ	l	ə	l	e
107	103	180	115			1990		51	76	58	50	60	57	83
210		295							134		110		140	
		(14) 295				(15)								

dans la bataille? Il

'z	a	ʁ	ʤ	ã	l	a	b	a	't	a	j	^	i	l
57	73	35	40	57			70	67	108	265			60	30
165			97		88		137		373				90	
			(16)		695							1325	(17)	

abandonne sa queue pour sauver

a	b	ã	'ʤ	ɔ	n	s	a	'k	ø	p	u	ʁ	s	ɔ
58	60	86	67	75	73	117	67	118	120	92	54	39	90	49
58	146		215			184		238		185			139	
509						(18)	422			(19)			696	

le gros de ses forces

v	e	l	ə	'g	²ʁ	o	d	ə	s	e	'f	ɔ	ʁ	s
32	64	23	80	53	47	73	37	72	99	50	136	99		853
96		103		173			109		149					
							(20)							

Grande leçon! N'y en a-t-

'g	ʁ	ã	l	ə	's	õ	^	n	j	ã	n	n	a	t
99		126	68	73	114	107		79			14	14	83	45
225			141		221			93			142			
(21)	225		(22)		362		1539	(23)				550		

il pas beaucoup parmi

t	i	l	'p	a	b	o	'k	u	p	a	ʁ	m	i	
44	51	45	100	75	60	63	72	98	60	65	67	60	85	
140			175		123		170		192			145		
					(24)	293			(25)				572	

nous dont le corps offre des

'n	u	^d	õ	l	ə	'k	ɔ	ʁ	ɔ	f	ʁ²	d	e	
65	170	480	77	33	67	88	168	67	115	140	41	38	52	
235				100		323			115	181		90		
		(26)							(27)					

parties condamnées d'avance

p	a	ʁ	t	i	'k	õ	ʤ	a	n	e	d	a	'v	ã
59	50	45	100	36	82	160			65	60	67	98	55	138
154			136		242		97		125		165			375
918							(28)				375			

parce qu'elles n'ont pas, pour

s	^p	a	ʁ	s	k	ɛ	l	'n	õ	'p	a	^p	u	ʁ
182	385	95		65	50	92	43	110	130	123	204	815	113	50
					185			240		327				
	(29)									(30) 327		(31)		

eux, un intérêt vital?

ˈø	œ̃	ɛ̃	t	e	ʁ	ɛ	y	i	ˈt	a	l	^	p	u
208	107	96	54	50	30	50			100	82	88	1792		47
208	107	96	104		80		113		270					
	(32)		770									(33)		

Pourquoi l'écureil a-t-il

ʁ	ˈk	w	a	l	ɛ	k	y	ˈʁ	œ	j	a	t	t	i
38	56	117				108	92	28	137		87	60	60	73
	173			77		200		165			147		193	
				(34)							(35)			

une queue presque aussi grosse

l	y	n	ˈk	ø	ˈp	ʁ	ɛ	s	k	o	s	i	ˈg	ʁ
60			83	80	90	70		57	50	45	95	65	38	47
	115		163		217				95		160		223	
618					(36)	217			(37)			478		

que lui et qui le suit

o	s	k	a	ˈl	y	i	^	e	k	i	l	a	ˈs	y
66	72	60	102	60	80	145		97	90	76	35	80	145	70
		162		285				97	166		115		215	
		(38)	447				540	(39)			575			

comme un reproche? Que

i	k	ɔ	m	œ̃	ʁ	ə	ˈp	ʁ	ɔ	ʃ	^	k	ə	
	84	46	65	85	45	78	142	138		142	1495	100		
	195			85	123		422							
	(40)			825							(41)			

fait la truie de tant de

ˈf	ɛ	l	a	ˈt	ʁ	y	i	d	ə	t	ã	ð	ə	
105	70	23	87	173	47	115		43	55	87	80			
175		110		335				98		167		90		
		(42)		445				(43)		265		(44)		

mamelles? Est elle bien

m	a	ˈm	ɛ	l	^	ɛ	t	t	ɛ	l	ˈb	j	ɛ̃	
45	80	98	97	105		67	37	37	70	51	58	145		
125		300				104		158			203			
615					1080	(45)		465						

sûre de ne pas en

ˈs	y	ʁ	d	ə	n	ə	ˈp	a	z	z	a	n	n	a
154	126	54	43	60	45	136	100	112	17	17	71	18	18	119
334			103		181		229			106			137	
(46)	334		(47)		513					(48)			673	

avoir une bonne moitié

ˈv	w	a	ʁ	^	y	m	ˈb	ɔ	m	m	w	a	t	je
70	270		90				65	53	55	56	69		99	35
430					140		173			125			134	
				45	(49)		313			(50)			612	

de trop?" "Elle en est parfaitement

d	ə	ˈt	ʁ	o	^	ɛ	l	ɑ̃	ɛ̃	ˈp	a	ʁ	f	ɛ
38	68	157	90					64	56	60	76		89	55
106		247				150		64	56	136			224	
					1140	(51)		406					(52)	

sûre", dit la truie

t	m	ɑ̃	ˈs	y	ʁ	^	d	i	l	a	ˈt	ʁ	ɥ	i
80	68	102	135	195			65	37	33	66	100	92	77	
	150		330				104		99		269			
704					445	(53)		472						

de sa place. "Qu'elle interroge

d	ə	s	a	ˈp	l	a	s	^	k	ɛ	l	ɛ̃	t	e
33	70	92	38	104	143		110	1091		63	31	105	52	83
103		130		357								105	135	
(54)		590						(55)						

sa conscience!" "Sa

ˈʁ	ɔ	ʒ	s	a	k	õ	ˈs	j	ɑ̃	s	^	s	a	
40	130	40	47	63	65	140	135	185		150		105	60	
210			110		205		470					165		
			(56)		785						670	(57)		

conscience la laisse

k	õ	ˈs	j	ɑ̃	s	l	a	l	ɛ	s	ˈp	a	ʁ	
75	105	135	38	74	83	83		70		64	80	73		
180		330				83		134			153			
675						(58)		370						

parfaitement en repos". "C'est ce

f	ɛ	t	ˈm	ɑ̃	ɑ̃	ʁ	ə	ˈp	o	^	ˈs	ɛ	s	
140	44	98	88	90	96	43	75	114	92		75	70	40	
282			178		96	118		206			185			
(59)		460			(60)	420				900	(61)	185		

que nous verrons", dit le lion,

k	ə	n	u	ˈv	ɛ	ʁ	õ	^	d	i	l	ə	ˈl	jɛ̃
55	60	60	83	67	130	62	110				49	80	136	155
115		143		197		172			105		129		291	
(62)		627						233	(63)		525			

très maître de lui. Et

ˈt	ʁ	ɛ	m	ɛ	t	ʁ^{ə}	d	ə	ˈl	y	i	^	e
120	60	60	50	80	125	45	50	80					70
240			130		170		130		180				70
(64) 240		(65)			610							1255	(66)

chacun songeait à part soi.

ʃ	a	ˈk	œ̃	s	õ	ˈʒ	ea	p	a	ʁ	ˈs	w	a	^
85	75	75	115	115	155	70	145	90	77		200	180		
160		190		270		215		167			380			
420				(67)	485			(68)	547					940

"Moi, je n'ai absolument

ˈm	w	a	ʒ	ə	n	ɛ	a	ɓ	ˈs	ɔ	l	y	ˈm	ã
96	222		90	65	60	58	57	80	135	75	55	76	88	140
318			155		118		137		210		131		228	
(69) 318			(70)		620						(71)	359		

rien de trop. Je tiens à

ˈʁ	j	ɛ̃	ð	ə	ˈt	ʁ̥	o	^	ʒ	ə	ˈt	j	ɛa
126	141		25	59	174		107		58	70	92	38	135
267			84		281				128		265		
(72) 267			(73)		365			747	(74)		393		

tout ce qui me concerne". "Nous

ˈt	u	s	k	i	m	k	õ	ˈs	ɛ	ʁ	n	^	n	u
95	105	68	79	123		58	127	120	57	138				
268			202			185		315					85	
(75) 268			(76)			702						1070	(77)	

trouverions aussi chez

ˈt	ʁ	u	v	ɛ	ʁ	i	j	õ	o	ˈs	i	ʃ	e
65	40	125	40	95	48	36	36	75	134	203	150	91	44
230			135		83		111		134	353		135	
315			(78)		816							(79)	

certains d'entre nos frères

s	ɛ	ʁ	ˈt	ɛ̃	ð	ã	f	ʁ^{ə}	n	o	ˈf	ʁ	ɛ$^{(ʁ)}$
103	63		121	110	41	120	124	49	37	80	170	110	
166			231		161		173		117		280		
532					(80)			731					

bien-aimés", poursuivit le

ˈb	j	ɛ̃	ɛ	ˈm	e	p	u$^{(ʁ)}$	s	y	i	v	i	l	ə
114	126		89	71	120	95	44	136	75		46	78	50	97
240			89	191		139		211			124		147	
(81) 240			(82)	280		(83)					956			

lion, "une ou deux livres

ˈl	j	õ	^	ˈy	n	^	u	ˈd	ø	l	i	v	ʁə	
180		155		235	170		92	83	107	72	78	122		
335				405			92	190		150		122		
			790	(84)405		145	(85)280			(86)				

de viande qui ne leur sont

d	ə	ˈv	j	ã	d	əw	k	i	n	l	œ	ʁ	s	õ
48	57	50	115		86	210	74	90		50	75	63	70	120
105		165			296		164			188			190	
880							(87)						746	

pas indispensables".

ˈp	a	z	z	ɛ	d	i	s	p	ã	ˈs	a	b	l	^
85	103	16	16	74	115		50	40	97	130	82	1644		
204			90		165			137						
			(88)											

"Et toi, pourquoi tu as la

e	ˈt	w	a	p	u	ʁ	ˈk	w	a	t	a	l	a	
116	123	70	257	105	75	32	58	40	124	156	40	25	87	
116	450			212			222			196		112		
(89)	566			(90)	434					(91)		544		

tête si grosse?" dit brusquement

ˈt	ɛ	t	s	i	ˈg	ˈʁ	o	z	d	i	ʁ	ʁ	y	s
96	62	78	107	70	55	78	122	40	40	70	82		58	58
236			177		295				110		198			
			(92)		472				(93)				654	

un ours énorme

k	ə	ˈm	â	œ	n	ˈn	u	ʁ	s	e	ˈn	ɔ	ʁ	m
52	99	68	127	115		82		51	101	84	52	144	40	56
151		195		115		234				84	292			
				(94)		349				(95)	376			

qui avait gardé le silence

k	j	a	v	ɛ	ˈg	a	ʁə	d	e	l	ə	s	i	
63	72		43	54	58	50	58	59	58	71		124	40	
135			97		166			117		71		164		
(96)		398						(97)			532			

jusqu'alors. "Il

ˈl	ã	s	ʒ	y	s	k	a	ˈl	ɔ	ʁ	^	i	l	
160		20	50	80	56	59	67	65	178			70	45	
180			186			126		243				115		
			(98)		555						1544	(99)		

faut bien que j'aie assez de place

f	o	ˈb	j	ɛ̃	k	ə	ˈʒ	ɛa	s	e	d	ə	ˈp	l
84	81	53	37	140	65	87	68	90	100	50	40	77	113	30
165		230			152		158		150		117		303	
510					(100)		310		(101)		570			

pour penser à chacun de

a	s	ɒ	u	ɓ	ˈp	ã	s	ea	ʃ	a	k	œ̃	ð	ə
113	47	54	69		77	114	98	80	83	56	53	107	53	99
		123			191		178		139		160		152	
		(102)			314		(103)				770			

vous", riposta le lion,

ˈv	u	ɓ	i	ɒ	ɔ	s	ˈt	a	l	ə	ˈl	j	õ	^
75	66	36	65	164	120	75	75	93	52	75	235		130	
141		100		359			168		127		365			
		(104)		627					(105)		492			1170

"mais voulant vous montrer

m	ɛ	v	u	ˈl	ã	v	u	ˈm	õ	t	ɓ	e	m	o
		71	49			72	65	58	140	86		56	53	40
120		120		145		137		198		142			113	
(106)		385				(107)	335			(108)				

mon esprit de sacrifice

n	n	ɛ	s	ˈp	ɓ	i	ð	ə	s	a	k	ɓ	i	
20	20	45	67	66	62		15	54	96	45	120	65		
	137			128			69		141		185			
520							(109)							

je mets à la

ˈf	i	s	^	ʒ	ə	ˈm	ɛ	z	z	a	l	a	d	i
130	80	1065		40	70	48	61	18	18	60			63	54
				110		127			78		68		180	
				(110)		237			(111)					

disposition de tous,

s	p	o	z	i	ˈs	j	õ	ð	ə	ˈt	u	s	ˈg	ɓ
63	65	79			77	90		49	78	122	173	84	71	
	144		98		167			127		379				
735								(112)		506			(113)	

grands et petits, en commençant

ã	z	z	e	ɒ	ə	ˈt	i	^	ã	ˈk	ɔ	m	ã	
160	30	30	45	97	58	170	110		123	90	105	85	165	
261		75		155		280			123	195		250		
261		(114)		460				597	(115)	318		(116)		

par les petits, ma royale

ˈs	ɑ̃	p	a	ʁ	l	e	p	ə	ˈt	i	m	a(n)	ʁ	wa
145	165	44	56	35			83	80	175	150	85	280		
310		135			87		163		325		365		150	
560		(117)			710						(118)		695	

crinière". Se fut

ˈj	a	l	ˈk	ʁ	i	n	jɛ	ʁ	^	s	ə	ˈf	y	t
40	140		200		60					110	92	70	72	17
180			260			200				202		159		
			(119)			460			1693	(120)		361		

un éclat de rire, un

t	œ̃	n	n	e	ˈk	l	a	d	ə	ˈʁ	i	ʁ	^	œ̃
17	62	17	17	70	110	30	63	47	153	62	320			80
96			87		203			200		382				80
(121)			386					(122)		582			470	(123)

large éclat de rire qui

ˈl	a	ʁ	ʒ	e	ˈk	l	a	d	ə	ˈʁ	i	ʁ	^k	i
55	105	45	46	59	88	34	48	53	97	57	258		510	85
251				59	170			150		315				
331				(124)	229			(125)		465			(126)	

laissa le lion déconfit.

l	ɛ	ˈs	a	l	ə	ˈl	j	õ	ð	e	k	õ	ˈf	i
58	107	110	100	58	82	58	84	78	100		47	78	90	115
165		210		140		220			100		125		205	
				(127)	360				(128)		430			

"Vous me faites beaucoup de peine",

^	v	u	m	ˈf	ɛ	t	b	o	k	u	t	ˈp	ɛ	n
				115	92	65	68	63	92	65	90	87	123	70
	180			272			131		247			280		
1250	(129)			452			(130)				658			

reprit-il, retenant

ʁ	ə	p	ʁ	i	t	ˈt	i	l	^	ʁ	ə	t	ɑ̃	
33	40	100	85		70	70	83	167				75	40	
73		255				320				78		115		
(131)		648							167	(132)				

mal des larmes qui lui

n	ɑ̃	ˈm	a	l	d	e	ˈl	a	ʁ	m	k	i	l	yi
49	84	147	153	184	113	75	60	105	68	82	92	34		
133		484			188		315				126		125	
810					(133)		503				(134)			

venaint, on ne sait par quel

v	ə	'n	ɛ	o	n	n	ə	's	ɛ	p	a	ʁ	'k	ɛ
39	96	60	88	61	30	30	61	154	70	68	50	27	80	45
135		148		91		91		224		145			180	
534				(135)		406				(136)			325	

canal, de son voisin

l	k	a	'n	a	l	d	ə	s	õ	v	wa	'z	ɛ̃
55	90	65	70	83	57	40	48	102	75	40	100	42	80
	155		210			88		177		140		122	
	(137)		365			(138)			527				

le crocodile. Mais son

l	a	k	ʁ	ɔ	k	ɔ	'd	i	l	^	m	ɛ	s	õ
	104		46	103	84	48	207						76	96
73	150			187		255					69		172	
(139)	665									1548	(140)			

discours fut interrompu

ʒ	i	s	'k	u	ʁ	f	y	t	t	ɛ̃	l	e	ʁ	õ
29	79	77	44	115	25	60	43	25	25	132	55	80	45	150
185			184			128			157		135		195	
610						(141)				748				

par les hourras qui accueillirent

'p	y	p	a	ʁ	l	e	u	'ʁ	a	k	ja	k	ø
60	73	56	96	28			140	55	185	185	95	75	145
133		180			97		140	240		280		220	
		(142)			657					(143)		806	

les anges et leurs paniers

'j	i	ʁ	l	e	z	'z	ã	ʒ	e	l	œ	ʁ	'p	a
100	116	90	53	111	29	29	97	122	68	150		50	158	92
306			193			248			68	200			250	
			(144)		441				(145)		518			

de provisions.

n	j	e	d	ə	p	ʁ	ɔ	v	i	'z	j	õ	^
65	60	60	60	115	82	32	78			110		120	
185			175		192			56		230			
(146)					838								1425

Oui, tout serait allé

'w	i	^	't	u	s	ə	ʁ	ɛ	t	t	a	l	e
55	146	659		70	74	31	30	51	27	27	72	38	60
201					105		108			99		98	
(147) 201		(148)			(149)					957			

pour le mieux sans cette

p	u	ʁ	l	ə	ˈm	jø	^	s	ɑ̃	s	ɛ	t	ə
90	100				131	132		78	93	87	68	80	47
190			94		263			171		155		127	
							687	(150)				741	

pluie qui ne cessait point.

ˈp	l	ɥi	k	i	n	ə	s	ɛ	s	ɛ	ˈp	w	ɑ̃
138	45	105	95	38	35	47	105	59	96	49	137		116
288			133		82		164		145		253		
			(151)				777						

Pas une seconde de

^	p	a	z	z	y	n	s	ə	ˈg	õ	d	ə
1028		134	33	33	85	74	107	93	53	168	24	68
				192			200		221		92	
(152)											(153)	

sèche pendant les vingt-quatre

ˈs	ɛ	ʃ	p	ɑ̃	ɛ̆	ɑ̃	l	e	ˈv	ɛ̃	k	a
220	138	180	80	70	53	63	35	70	61	149	75	62
538			150		116		105		210		137	
630			(154)				581				(155)	

heures de la journée.

ˈʁ	ʁ	œ(ʁ)	d	ə	l	a	ˈʒ	u	ʁ	n	e
126	52	107	73	72			70	42	33		
285			145		113		145			150	
422			(156)				555				

French - Noah's Ark
Leader-timed analysis

| Orthography | Le lion, qui n'eut pas de peine à | | |

mamelles? Est elle bien sûr de ne pas en

m a	ˈm ɛ l	‿	ɛ t ʀ ɛ l	ˈb j ɛ̃	ˈs y ʁ d e n ə	ˈp a z z ã n n a
	300			203	618	472

avoir une bonne moitié de trop?" "Elle en est

ˈv w a ʁ	‿	y m	ˈb ɔ m m w a ʀ j e d ə	ˈʀ ʁ o	‿	ɛ l ã ɛ	ˈp a ʁ
430			538	247			

parfaitement sûr." dit la truie de sa place. "Qu'elle

f ɛ t m ã	ˈs y ʁ	‿	d i	l a	ˈʀ ʁ ɥ i d ə s a	ˈp l a s	‿	k ɛ l ɛ̃
510	330				502	357		

interroge sa conscience!" "Sa conscience la laisse

ʀ e	ˈʁ ɔ ʒ s a k õ	ˈs j ã s	‿	s a k õ	ˈs j ã s	l a	l ɛ s	ˈp a ʁ
	525	470			547			435

parfaitement en repos." "C'est ce que nous verrons", dit le lion

f ɛ t	ˈm ã ã ʁ ə	ˈp o	‿	ˈs ɛ s k ə n u	ˈv ɛ ʁ õ	‿	d i	l ə	ˈl j õ
	392	206		443	369				291

très maître de lui. Et chacun songeait à part soi.

ˈʀ ʁ ɛ m ɛ t ʁ̥ d ə	ˈl ɥ i	‿	e ʃ a	ˈk œ̃ s õ	ˈʒ ɛ̃ a p a ʁ	ˈs w a	‿
670	180			460	382	380	

"Moi, je n'ai absolument rien de trop. Je tiens à

ˈm w a ʒ ə n ɛ a b	ˈs ɔ l y	ˈm ã	ˈʁ j ɛ̃ ð ə	ˈʀ ʁ o	‿	ʒ ə	ˈʀ j ɛ̃ a
728	341	228	351	281			265

tout ce qui me concerne." "Nous trouverions aussi chez

ˈt u s k i m k õ	ˈs ɛ ʁ n	‿	n u	ˈʀ ʁ u v ɛ ʁ i j õ o	ˈs i ʃ e
655	315			693	654

certains d'entre nos frères bien-aimés" poursuivit

s ɛ ʁ	ˈʀ ɛ̃ ð ã ʀ ʁ̥ n o	ˈf ʁ ɛ (ʁ)	ˈb j ɛ̃ ɛ	ˈm e p u ʁ s ɥ i v i
	682	280	329	812

le lion, "une ou deux livres de viande qui ne leur

l ə	ˈl j õ	‿	ˈy n	‿	u	ˈd ø l i v ʁ̥ d ə	ˈv j ã d ə k i n l œ ʁ̥
	335		405			567	1003

son pas indispensables." "Et toi, pourquoi tu as

s õ	ˈp a z z ɛ̃ ð i s p ã	ˈs a b l̥	‿	e	ˈt w a p u ʁ̥	ˈk w a t͡ʃ a
	596	392			662	530

la tête si grosse?" dit brusquement un ours

l a	ˈʀ ɛ t s i	ˈg ʁ o z d i β ʁ ɣ s k ə	ˈm ã œ n	ˈn u ʁ s e
	413	754	310	318

énorme qui avait gardé le silence jusqu'alors.

ˈn ɔ ʁ m k j a v ɛ	ˈg a ʁ̥ d e l ə s i	ˈl ã s ʒ ɣ s k a	ˈl ɔ ʁ	‿
524	518	492	243	

"Il faut bien que j'aie assez de place pour penser a chacun

| | | |

cessait point. Pas une seconde de sèche pendant les

s ɛ s ɛ	ˈp w ɑ̃	‿	p a z z y n s ə	ˈg õ d ə	ˈs ɛ ʃ p ɑ̃ ð ɑ̃ l e
	253			313	909

vingt-quatre heures de la journée.

ˈv ɛ k a	ˈt ʁ œ (ʁ) d ə l a	ˈʒ u ʁ n e	
347	543	295	

Spanish : Noah's Ark

Word-group timed analysis

Orthographic text	El león, que no									
Phonetic transcription	e	l	l	e	'o	n	,k	e	'n	
Segment duration ms.	55	50	55	80	105	215	267	74	40	
Syllable duration ms	105		135		320				142	
Stress Group duration N° + Pause duration	(1)		560				(2)			

tuvo ningún trabajo

o	't	u	β	o	n	ˌ	ŋ	'g	u	n	t	ˈr	a	
102	52	72	94		52	54	50	33	54	50	70	78		
	124		94		156			148			148			
	(3)	218			(4)		304				(5)			

en reunir a todo

'β	a	x	o	e	n	rr	eu	'n	i	r	a	t	o	ð	
24	133	105	54	56	52	65	80	59	66	30	115	59	88		
157		159		108		145		155			115	147			
464				(6)		408					(7)				

el mundo, tomó la

e	l	'm	u	n	ð	o	ˆ	t	o	'm	o	l	a	
62	46	80	100	105	165		255	83	42	68	40	71		
108		285			165				110		111			
820							(8)				(9)			

palabra. "Amigos

p	a	'l	a	β	r	a	ˆ	a	'm	i	ɣ	o	z	
38	56	46	129	43	20	131		80	45	80	30	83	47	
94		175		194				80	125		160			
574							797	(10)		365				

míos, saquemos ejemplo

'm	i	o	s	ˆ	s	a	'k	e	m	o	s	e	'x	e	
50	67	143	150		133	82	60	50	62	74	66	43	55	67	
117		293			215		110		202			43		215	
(11)	410			90	(12)			527				(13)			

de nosotros

m	p	l	o	ð	e	n	o	's	o	t	r	o	z	
93	62	34	51	56		55	75	68	59	32	62	51	51	
	147			56		130		125		196				
405				(14)				507						

mismos, y conservemos

'm	i	z	m	o	s	^	i	k	o	n	s	e	r	
52	54	48	112	98	122		86	44	67	63	57	65	29	
154			332				86	174			151			
(15)			486			68	(16)				684			

nuestra sangre

'β	e	m	o	z	n	w	e	s	t	r	a	's	a	ŋ
		85	60	36	93		45	40	65			40	65	65
92		181			138			105				170		
					(17)							508		

fría. ?Qué hace el

ɣ	r	e	'f	r	i	a	^	'k	ea	θ	e(1)	l	a	
43		52	83	111		144	970		210	85	92	54	79	
95			195			144				177		133		
			(18)	339			(19)					(20)		

lagarto cuando pelea?

'ɣ	a	r	t	o	'k	w	a	n	ò	o	p	e	'l	e
32	78	65	60	55	40	65		85	70		45	52	45	74
175			115		190				70		97		119	
423					(21)		260						(22)	412

Pierde la cola para

a	^	'p	je	r	ð	e	l	a	'k	o	l	a	p	a
196	770		127	38	69		48	80	60	127	191		96	68
196					69		128		187		191		164	
	(23)						(24)		506				(25)	

salvar el grueso

r	a	s	a	l	'β	a	r	e	l	'ɣ	r	w	e	s
27	82	80	97		34	76	23	106		76		81		59
109		177			133			106		157				
583								(26)		377				

de sus fuerzas.

o	ð	e	s	u	s	'f	w	e	r	θ	a	s	^
55		60	73	58	53	70		55	93	110	97	430	
114	87		191		178				300				
	(27)				756							(28)	

!Gran lección! ?No

'g	r	a	n	l	e	k	'θ	j	o	n	^	'n	o	
	50	67	53	40	80	53	52	75		225		63	89	
				173			352					152		
				(29)		525					670	(30)	152	

tenemos muchos de

t	e	'n	e	m	o	z	'm	u	tʃ	c[2]	ð	e	n	o
53	49	31	92	60	83	45	62	75	60	72	60		52	78
102		123		188			137		132		60		130	
(31)		413					(32)		269		(33)			

nosotros partes del

's	o	t	ªr	o	s	'p	a	r	t	e	z	ð	e	l
64	90	85	40	113	70	93	72	55	70	85		138		
154		308				220			155			138		
652						(34)		373				(35)		

cuerpo que puedan

'k	w	e	rª	p	o	k	e	'p	w	e	ð	a	n	
68	88		71	101	118	41	84	61	85		69		66	
227				219		125		164			135			
584						(36)		424						

ser sacrificados

's	e	rª	s	a	k	r	i	f	i	'k	a	ð	o	s
73	65	44	60	63	40	98	40	62	62	85	100		82	
182			123		138		102		147		182			
(37) 182			(38)				692							

primero porque no

p	ªr	i	'm	e	r	o	^p	o	rª	k	e	'n	o
64	92		113		154		552	72	53	35	52	56	74
156			113		154					87		130	
(39)			423				(40)						

tienen un vital

't	je	n	e	n	u	m	β	i	't	a	l	i	n	
70	120	160			60	65	73		65	56	49	105		
190		160			125		73		170			105		
(41)	250				(42)		368					(43)		

interés para nosotros?

t	e	'r	e	s	p	a	r	a	n	o	's	o	t	ªr
41	58	33	101	78	67	58	25	49	51	50	80	92	47	42
99		212			125		74		101		172		278	
416					(44)				750					

?Porqué la ardilla

o	s	^p	o	rª	'k	e	l	a	rª	'ð	i	ʎ	a
80	109	1207	66	82	70	100	38	69	30	30	96	111	141
					170		137			126		252	
		(45)					(46)			515			

tiene una cola casi

't	j	e	n	eu	n	a	'k	o	l	a	'k	a	s	i
100	58		32	105	35	63	57	85	40	81	57	65	100	38
158			137		98		142		121		122		138	
(47)	295				(48)	361					(49)	260		

tan grande como ella

t	a	n	'ɣ	r	a	n	ð	e	k	o	'm	we	ʎ	a
36	68	95	35		90	100	25	60	53	61	86	190	205	
199			225				85		114		311		205	
(50)	509								(51)	630				

y que le sigue como un

^	i	k	e	l	e	's	i	ɣ	e	k	o	m	u	n
	93	50	47	45	61	83	69	135		38	45	40	49	68
	93	97		106		218		135		83		157		
337	(52)	649								(53)				

castigo? ?Qué hace la

k	a	s	't	i	ɣ	o	^	'k	ea	θ	e	l	a	
30	90	53	49	101	43	154	1095		200	68	52	37	73	
183		150		197						120		110		
770							(54)					(55)		

cochina con tantas

k	o	'tʃ	i	n	a	k	o	n	't	a	n	t	a	z
37	94	73	65	59	100	27	42	93	25	50	78	32	59	58
131		138		159		162			153			149		
538						(56)			464					

mamas? ?Está muy segura

'm	a	m	a	s	^	e	s	't	a	m	ui	s	e	
67	71	61	104	135		70	57	55	75	70	105	78	90	
138		300				127		130		175		168		
(57)	438				773	(58)	257			(59)	640			

que no le sobra

'ɣ	u	r	a	k	e	n	o	l	e	's	o	β	r	a
132		35	130	75	52	46	43	41	82	81	120	49		206
132		165		127		89		123		201		255		
				(60)		595								

por la menos la mitad?"

p	o	r	l	o	'm	e	n	o	z	l	a	m	i	
80	60	50	90		65	55	55	65	52	48	45	130		
190			90		120		172			93		130		
(61)	572									(62)	468			

"Perfectamente

'ta θ	^ per 'fe ɣ ta	'men
53 112 80	930 75 57 56 77 65 50 49	41 68 73
245	198 99	182
	(63)	(64) 306

segura", dijo la

te	se 'ɣu ra	'ði xo	la
49 75	53 74 129 34 125	150 105 67 47	30 83
124	127 129 159	255 114	113
	(65) 415	(66) 369	(67)

cochina. "!Que le pregunte

ko 'tʃi na	^ ke le	e pre
32 85 60 87 38 142	920 68	89 22 34 79
117 147 180		89 135
557	(68)	

a su conciencia!"

'ɣu n	ta	sukon 'θ	jen	θja
26 80 60	25 75	59 61 25 60 80	39 101	85 77 140
166	100	120 165	225	217
		(69) 727		

"Su conciencia le deja

^	sukon 'θje	nθja	le 'ðe
	90 63 28 74 70 48 95	79 71 85	39 50 41 99
	153 172 219	156	89 140
915	(70) 700		(71) 469

absolutamente

xa β	so 'lu ta	'men ðe
98 97 45	72 42 41 58 37 58	57 53 67 27 83
240	114 99 95	177 110
	(72) 308	(73) 287

tranquila." "Eso lo

tr a ŋ 'ki la	^	'eso lo
35 60 85 35 80 68 102		127 70 64 32 60
180 115 170		127 134 92
(74). 465	1120	(75) 261 (76)

veremos," dijo el león

β e 'r e m o z	'ði	x we'	le 'on.
32 56 26 81 98 84 56	50 97	75 105	37 60 134 196
88 107 238	147	180	97
525	(77)	327	(78)

segurisimo de

s	e	ɣ	u	ˈr	i	s	i	m	o	ð	e	s	i	
128	65	39	48	20	112	100	70	37	46	30	50	67	60	
193		87		132		170		83		80		127		
(79)				665						(80)		571		

simismo. Y cada uno pensaba

ˈm	i	z	m	o	^	i	k	a	ˈt͡ʃ	au	n	o	p	e
59	75	54	72	104		86	62	80	30	128	90	132	68	50
188			176			86	142		158		222		188	
					907	(81)			608				(82)	

por su parte.

n	ˈs	a	β	a	p	o	r	s	u	ˈp	a	r	t	e
70	72	92	23	98	50	57	35	48	57	49	76	67	122	65
	164		121		142			105		192			187	
473					(83)			626						

"Pues yo, no tengo

^	p	w	e	z	ˈj	o	^	ˈn	o	ˈt	e	n	ɣ	wa
853		96		88	208			104	91	50	117	49	34	82
					208			195		216			164	
(84)							80	(85) 195		(86)			380	

absolutamente nada

β	s	o	ˈl	u	t	a	ˈm	e	n	t	e	ˈn	a	
48	39	44	98		35	69	57	83	85	67	72	71	120	
	83		98		104		225			129		191		
	(87)		285				(88)		354			(89)		

que me sobre." "Yo

k	a	k	e	m	e	ˈs	o	β	r	e	^	ˈd͡ʒ	o	
32	89	49	60	54	56	69	108	40	48	114		85	105	
119		109		110		177		202				190		
310		(90)		598							533	(91)	190	

necesito todo lo

n	e	θ	e	ˈs	i	t	o	ˈt	o	ð	o	l	o	
55	68	50	62	50	115	90	125	105	115	35	77	83		
123		112		165		215		220		112		83		
(92)		615						(93)	332			(94)		

que tengo." "Podríamos

ɣ	e	ˈt	e	ŋ	g	o	^	p	o	ˈð	r	i	a
20	68	51	81	103	38	106	1173		80	100		83	
88		235			144					100		83	
550							(95)						

encontrar también

m	o	s	e	ŋ	k	o	n	ˈt	ˀr	a	rˀ	t	a	m
40	82	74	49	32	55	68	72	40	38	96	61	69	60	64
196			81		195			235				193		
			(96)		511							(97)		

entre algunos

ˈβ	je	n	^	e	n	t	ˀr	ea	l	ˈɣ	u	n	o	z
33	125	175		44	69	51	52	53	33	49	100	40	63	29
333				113		138				149		132		
526			90	(98)		532								

de nuestros - nosotros

ð	e	ˈn	we	s	t	ˀr	o	s	^	n	o	ˈs	c	
29	37	50	69	61	93	107		125		83	67	75	92	
66			180			325				150		167		
(99)			571						345	(100)		530		

queridos hermanos",

t	ˀr	o	s	k	e	ˈr	i	ð	c	s	e	rˀ	ˈm	a
50	30	76	57	53	42	27	63	29	77	63	50	55	47	80
213				95		90		169			105		127	
				(101)		354					(102)		449	

continuó el leon,

n	o	s	^	k	o	n	t	i	ˈn	wc	e(ı)	l	e	
40	92	85	441		74	56	43	41	43	163	90	73		
217							84		206		90	73		
			(103)								(104)		440	

"una o dos libras

ˈo	n	^	ˈu	n	ao	ˈð	o	z	ˈl	i	β	r	a	z
132	145		190	68	98	36	94	64	40	50	37	35	80	23
277			190	162		194			90		175			
		445	(105)	352		(106)	194		(107)		265			

de carne que no nos

ð	e	ˈk	a	rˀ	n	e	k	e	ˈn	o	n	o	s	
23	76	50	98	56	73	138	103	52	43	67	47	73	44	
99			204		211		155		110		164			
(108)			514				(109)	265			(110)			

son indispensables."

ˈs	o	n	i	n	ð	i	s	p	e	n	ˈs	a	β	l	e
44	72	56	45	40	23	51	50	50	55	44	62	97	178		
172			85		124			149			159				
336			(111)						785						

"Y tú, porqué tienes

s	^	i	't	u	~ p	c	r ʲ	ɣ	e	't	je	n	e
90		120	47	243	247	75	50	40	82	38	110	49	66
268		120	290					122		148		165	
	1120	(112) 410			(113)					(114)		313	

la cabeza tan grande?"

z	l	a	k	a	'β	e	θ	a	d	a	ŋ	'ɣ	ʲr	a
50	32	72	20	100	36	62	38	72	40	71	59	22	43	60
	104		120		98		110		170			182		
	(115)		432						(116)			585		

dijo bruscamente

n	ð	e	^	'd	i	x	o	'β	ʲr	u	s	k	a	
57	31	202		34	98	89	81	30	48	52	70	58	55	
	233			132		170		200				113		
			513	(117)		302		(118)			313			

un oso enorme

'm	e	n	t	eu	n	'o	s	we	'n	o	rʲ	m	e	^
77	79	106	38	97	53	93	74	65	45	85	57	70	143	
262			188			93	139		185			213		
(119)		450				(120)	232		(121)		390			

que había estado callado

k	ea	'β	i	e	s	't	a	ð	o	k	a	ʎ	a	
240	105	25	95	90	55	64	85	26	90	34	65	66	95	
		120		145		149		116		99		161		
(122)						(123)		265		(124)			440	

hasta entonces. Es

ð	wa	s	t	e	n	't	o	n	θ	e	s	^	e	z
59	81	40	45	80	70	47	73	81	80	84	87		110	53
180			195			201			251				163	
			(125)			647						1043	(126)	

muy necesario que yo

'm	ui	n	e	ð	e	's	a	r	i	o	k	e	'j	o
69	158	113		107		75	85	28	57	150	90	55	45	105
227		113		107		160		85		150	145		150	
390		(127)				615					(128)		295	

tenga bastante

't	e	ŋ	ɣ	a	β	a	s	't	a	n	r	e	s	
53	72	103	22	77	108		45	47	60	66	57	114	53	
281			99		153			173			224			
(129)		380			(130)			550						

espacio para pensar

ˈp	a	θ	j	o	p	a	r	a	p	e	n	ˈs	a	r
82	101	120	115		105	57	26	85	61	65	54	85	113	25
183		235			162		111		180			243		
(131)		418			(132)				696					

en cada uno de vosotros",

e	ŋ	k	a	ˈð	au	n	o	ð	e	β	o	ˈs	o	
42	68	65	75	185	50	65		30	60	30	80	64	115	
110		140		185	115			90		110		179		
(133)				550				(134)				630		

contestó el

t	ˈr	o	s	^	k	o	n	t	e	s	ˈt	o	e	l
61	48	92	50	518	70	56		66	70	55	55	75	55	43
251								191			130		98	
				(135)									(136)	

león. "Pero para

l	e	ˈo	n	^	p	e	ɾ	o	p	a	r	a	ð	e
57	68	60	132	1013	97	23	106	69	62	20	55	40	65	
125		192				129		131		75		105		
415				(137)										

demostraros mi espíritu

m	o	s	ˈt	r	a	r	o	z	^	m	je	s	ˈp	i
46	76	43	80	28	97	62	118		60	77	38	80	65	
165		205			180				175			145		
								85	(138)			520		

de sacrificio,

r	i	t	u	ð	e	s	a	k	ˈr	i	ˈf	i	θ	jo
25	61	49	65	27	58	57	83	45	60		35	105	105	167
86		114		85		140		105			140		272	
				(139)				742						

yo pongo a disposición

^	ˈdz	o	ˈp	o	ŋ	y	wa	ð	i	s	p	o	s	i
	60	130	62	107	74	37	85	60		50	85	83	32	49
	190		243			122		110			168		81	
508	(140)	190	(141)		365			(142)				550		

de todos, grandes

θ	jo	n	ð	e	ˈt	o	ð	o	s	^	ĝ	ˈr	a	n
50	95	46	44	96	40	95	40	113	93	459		44	129	67
191			140		135		246							
			(143)		521					(144)				

y chicos, empezando

ð	e	s	i	ˈtʃ	i	k	o	s	e	m	p	e	ˈθ	a
29	56	79	59	95	108	60	120	135	105	45	30	50	57	88
164			59	203		315			150		80		197	
			(145)		577				(146)			547		

por los chicos,

n	ð	o	p	o	r	l	o	s	ˈtʃ	i	k	o	s	^
52	40	80	43	63	44	30	40	47	107	86	69	110	116	
	120		150			117			193		295			
			(147)			460								295

mi real melena."

m	i	rr	e	ˈa	l	m	e	ˈl	e	n	a	^	ˈu	
40	65	68	84	68	65	50	70	270					138	
105		152		133		120		270					138	
(148)		390				(149)		390				1120	(150)	

Hubo una explosión de risas

β	ou	n	e	s	p	l	o	ˈs	jo	n	ð	e	ˈrr	i
107		94		90	55	20	58	63	90	75	26	70	27	119
107		184			133			228			96		146	
429					(151)		361				(152)			532

que dejó al leon

s	a	s	k	e	ð	e	ˈx	oa	l	l	e	ˈo	n	
84	107	99	71	49	36	71	94	155	35	55	45	68	67	
290			120		107		284			100		135		
			(153)		511					(154)	235			

desconcertado.

ð	e	s	k	o	n	θ	e	rˀ	ˈt	a	ð	o		
33	52	50	40	48	47	59	49	42	85	120	28	127	^	
135			135			150			205		155			
(155)						780							748	

"Me haceis mucho daño",

m	ea	ˈθ	ei	z	ˈm	u	tʃ	o	ˈð	a	ɲ	o	^	
70	87	83	132	41	39	123	67	60	25	143	82	155		
157		256			162		127		168		237			
(156)		413			(157)		289		(158)		405		200	

dijo, reprimiendo

d	i	x	o	^	rr	e	p	ˀr	i	ˈm	je	n	ð	o
47	114	101	166		38	102	22	23	60	205			25	58
161		267			140			105		205			83	
(159)		428		397	(160)			533						

con dificultad las

k	o	n	ð	i	f	i	k	u	l	't	a	ð	l	a
29	93		54	76	50	30	115		68	80	44		43	80
122			54	126		145			192				182	
(161)						639							(162)	

lágrimas que le

z	'l	a	ɣ	r	i	m	a	s	k	e	l	e	β	e
59	31	80	40	30	72	144		139	98	62	52	73	30	65
	111		142			283			160		125		95	
718									(163)				725	

venían, no se sabe por

'n	i	a	n	'n	o	s	e	's	a	β	e	p	o	r̄
60	115	82	88	80	68	52	90	62	103	35	90	68	32	66
175		170		148		142		165		125		166		
				(164) 148		(165)		432				(166)		

qué conducto, de su

'k	e	k	o	n	'ð	u	k	t	o	^	č	e	s	u
64	73	37	60	66	40	100	72	72	125		37	103	50	45
137		163		212				197			140		95	
303		(167)		572						330	(168)			

vecino el cocodrilo.

β	e	'θ	i	n	we	l	k	o	k	o	'ð	r	i	l
47	82	71	40	35	108	35	46	78	38	107	38		145	115
129		111		178			124		145		183			115
653							(169)				567			

Pero su discurso

o	^	p	e	r	o	s	u	ð	i	s	'k	u	r	s
	1175		90	20	70	75	48	47	78	49	68	75	60	100
				90		123		174			203			
	(170)													

fue interrumpido por

o	'f	wi	n	t	e	rr	u	m	'p	i	ð	o	p	o
90	98	140	34	28	65	53	61	76	66	99	31	105	82	65
190	272			93		190			165		136		186	
	(171) 272			(172)				584					(173)	

los hurras a los ángeles

r̄	l	o	s	'u	r	a	s	a	l	o	s	'a	ŋ	
39	37	86	110	135	60	110	60	60	30	57	63	40	60	
	258			135		230		60		150		100		
809								(174)					625	

y sus cestas

x	e	l	e	s	^	i	s	u	s	'θ	e	s	t	a
90	45	40	70	70		65	35	72	50	48	94	42	48	81
135		180				65	157			184			144	
					395	(175)				550				

de provisiones.

z	ð	a	p	'r	o	β	i	's	jo	n	e	s	^	
15	15	75	48	32	50	100		80	100	265				
	90		130			100		180		265				
	(176)					765							820	

Sí! Todo hubiera sido

's	i	^	't	o	ð	u	'β	je	r	a	's	i	ð	o
100	208	442		125	175		135		22	86	70	57	35	95
308					175		135		108		127		130	
(177)	308	(178)					(179)		243		(180)		257	

perfecto sin esta

p	e	r	'f	e	k	t	o	^	s	i	n	'e	s	t	a
35	59	39	75	95	75	75	137	208		44	52	91	55	68	52
153			245			212						146		120	
(181)			610					(182)							

lluvia que no paraba

'ʎ	u	β	ja	k	e	'n	o	p	a	'r	a	β	a	x
60	139	51	135	40	45	43	80	52	55	28	97	85		83
199		186		85		123		107		125		85		
(183)		385		(184)		208		(185)		317				(186)

jamás. Ni un segundo

a	'm	a	s	^	n	i	'u	n	s	e	'y	u	n	ð
64	38	135	130		35	100		145	85	75	83		62	30
147	303				135			145	160		145			
450				800	(187)			280	(188)		401			

seco en las veinti-

o	's	e	k	we	n	l	a	z	β	ei	n	t	i	
66	84	102	102	106	54	49	60	42	35	74	41	41	68	
96	186		262			151			150			109		
	(189)		448			(190)			571					

cuatro horas del día.

'k	wa	't	'r	o	r	a	z	ð	e	l	'ð	i	a	
43	118	23	52	77	31	76	42	45	132		43	103	117	
161		152			149			177			146		117	
		(191)			301			(192)			440			

Spanish : Noah's Ark

Leader-timed analysis

Orthography	El leónque no tuvo ningún				
Transcription	e l l 'e	o n	‸ k e	'n o	't u β o n i g
Stress group duration ms		320		142	374

trabajo en reunir a todo el mundo,

'g u n t ˀr a	'β a x o e n rreu	'n i r a t o ð e l	'm u n ð o	‸
296	569	525	450	

tomó la palabra. "Amigos míos, saquemos

t o	'm o l a p a	'l a β r a	‸ a	'm i ɣ o z	'm i o s	‸ s a	'k e
	315	369		285	410		

ejemplo de nosotros mismos, y

m o s e	'x e m p l o ð e n o	's o t ˀr o z	'm i z m o s	‸ i k o
355	548	321	486	

conservemos nuestra sangre fría. ?Qué hace el

n s e r	'β e m o z n w e s t ˀr a	's a ŋ ɣ r e	'f r i a	‸ 'k e a θ e
	516	265	339	

lagarto cuando pelea? Pierde la cola

(l) l a	'ɣ a r ˀr t o	'k w a n ð o p e	'l e a	‸ 'p j e ˀr ð e l a	'k o l
	290	357	315		

para salvar el grueso de sus fuerzas.

a p a r a s a l	'β a r e l	'ɣ r w e s o ð e s u s	'f w e r
828	239	549	478

Gran lección! ?No tenemos muchos

θ a s	‸ 'g ˀr a n l e k	'θ j o n	‸ 'n o t e	'n e m o z	'm u tʃ o z
		352	254	311	459

de nosotros partes del cuerpo que puedan

ð e n o	's o t ˀr o s	'p a ˀr t e z ð e l	'k w e ˀr p o k e	'p w e ð a
	462	513	571	281

ser sacrificados primero por que

n	's e r s a k ˀf i f i	'k a ð o s p ˀr i	'm e r o	‸ p o ˀr k e
	545	485	267	

no tienen un vital interes para nosotros?

'n o	't j e n e n u m β i	't a l i n t e	'r e s p a r a n o	's o
130	548	374	512	

?Porqué la ardilla tiene una cola casi

t ʔ r o s	p o r ʔ	k e l a r	ð i ʎ a	t j e n e u n a	k o l a	k a s
450		307	378	393	263	

tan grande como ella, y que le sigue como

i t a ŋ	ɣ r a n ð e	k o	m w e ʎ a	i k e l e	s i ɣ e	k o m u
459	424		516		776	

un castigo? ?Qué hace la cochina con tantas

ŋ k a s	t i ɣ o	k e a θ e l a	k o	tʃ i n a	k o n	t a n t a z
	347			459		302

mamas? ?Está muy segura que no le sobra

m a m a s	e s	t a m u i s e	ɣ u r a	k e n o l e	s o β r a
438		473	636		736

por lo menos la mitad? "Perfectamente

p o r ʔ l o	m e n o s l a m i	t a θ	p e r ʔ	f e ɣ t a	m e n t
	515	245		297	433

segura", dijo la cochina. "Que le pregunte

e s e	ɣ u r a	ð i x o l a k o	tʃ i n a	k e l e p ʔ r e	ɣ u n
	288	599	327		

a su conciencia". "Su conciencia le deja

t e a s u k o n	θ j e n θ j a	s u k o n	θ j e n θ j a l e	ð e x a β
551	442		464	494

absolutamente tranquila." "Eso lo veremos",

s o	l u t a	m e n t e t r a ŋ	ɣ i l a	e s o l o β e	r e m
	194	467	285	441	345

dijo el león, segurisimo de simismo.

o z	ð i x w e l l e	o n s e ɣ u	r i s i m o ð e s i	m i z m
	424		592	364

Y cada uno pensaba por su parte. "Pues

o	i k a	ð a u n o p e n	s a β a p o r s u	p a r ʔ t e	p w e z
		568	532	379	

yo, no tengo absolutamente nada que me

j o	n o	t e ŋ ɣ w a β s o	l u t a	m e n t e	n a ð a k e m e
208	195	463	202	354	529

sobre. Yo necesito todo lo que tengo".

s o β r e	dz o n e θ e	s i t o	t o ð o l o ɣ e	t e ŋ g o
379	425	380	503	379

"Podríamos encontrar también entre

| | | |

grandes y chicos, empezando por los chicos,

ˈgˠranðesi	ˈʧikosempe	ˈθanðoporlos	ˈʧi
	518	584	

mi real melena". Hubo una explosión de

kos	ˌmireˈalmeˈlena	ˈuβunesploˈsjonð
488	253 270	562 324

risas que dejó al león desconcertado.

eˈrrisaskeðeˈxoallelˈonðeskonθerˠˈtað
663 384 555 360

"Me haceis mucho daño", dijo, reprimiendo

o ˌmeaˈθeizˈmuʧoˈðaɲo ˌˈdixo ˌrrepˠriˈmjenˀ
256 289 405 428

con dificultad las lágrimas que le

okonðifikulˈtaˀlazˈlaɣrimaskeleβ
735 374 916

venían, no se sabe por qué conducto, de su

eˈnianˈnoseˈsaβeporˠˈkekonˈðuktoˌðes
245 290 456 300 409

vecino el cocodrilo. Pero su discurso

uβeˈθinwelkokoˈðrilo ˌpeɾosuðˌsˈkurˠ
558 298 393

fue interrumpido por los hurras a los ángeles

soˈfwinterrumˈpiðoporlosˈurrasalosˈaŋ
555 745 574

y sus cestas de provisiones.

xeles ˌisusˈθestazðeˠpˠroβiˈsjones
415 640 445

Sí! Todo hubiera sido perfecto sin esta

ˈsi ˌˈtoðuˈβjeraˈsˌðoperˈfektoˌsinˈest
243 410 457 308 266

lluvia que no paraba jamás. Ni un segundo

aˈkuβjakeˈnopaˈraβaxaˈmasˌniˈunseˈyun
470 230 357 303 305 241

seco en las vienticuatro horas del día.

ðoˈsekwenlazβeintiˈkwaˈtrorazðelˈðia
858 161 478 263

APPENDIX 6

Noah's Ark data used for experiment in Chapter VI

APPENDIX 6

Spanish, Noah's Ark, 5 informants

WT = Word-timed stress groups

LT = Leader-timed stress groups

All groups used in the corresponding tests in Chapter VI are underlined.

This underlining also indicates any differences in stress placement by individual informants.

Pauses are indicated by ‖ for each informant in the appropriate places.

A broad phonetic transcription is used (although informants may have differed in their realization of some segments).

All measurements in milliseconds.

		e l l e 'o n k e 'n o 't u
LR	Segments	66 63 63 74 104 93 27 66 50 78 48 78
	Syllables	129 137 197 93 128 126
	WT groups	221 220
	LT groups	290 128
AS	Segments	105 60 60 104 128 220 48 90 53 112 73 148
	Syllables	165 164 348 138 165 221
	WT groups	303 304
	LT groups	165
JG	Segments	62 48 49 80 123 216 52 76 44 90 60 76
	Syllables	110 129 339 128 134 136
	WT groups	262 240
	LT groups	134
JF	Segments	124 72 73 113 147 240 55 104 74 102 88 105
	Syllables	196 186 387 159 176 193
	WT groups	335 331
	LT groups	176
DP	Segments	78 30 31 85 58 77 65 52 55 93 64 96
	Syllables	108 116 135 117 148 160
	WT groups	265 258
	LT groups	148

	ß	o	n	i	ŋ	'g	u	n	t	ˀr	a	'ß	a	x
LR	94		60	52	50	13	80	60	18	60	61		108	67
	94		162			153			139				108	
			315										538	
	382					292								

AS	83		62	60	81	33	81	104	38	71	75	57	80		115
	83		203			218			185				137		115
			421										437		
	507					403									

JG	14	90	50	50	40	14	52	57	35	42	57	33	112		87
	104		140			123			134				145		
			263										513		
	380					257									

JF	49	89	81	66	93	30	105	86	53	78	70	63	147		113
	138		240			221			201				210		
			461										723		
	571					422									

DP	98		76	56	68	19	56	83	30	60	53	49	91		100
	98		200			158			143				140		
			358										543		
	458					301									

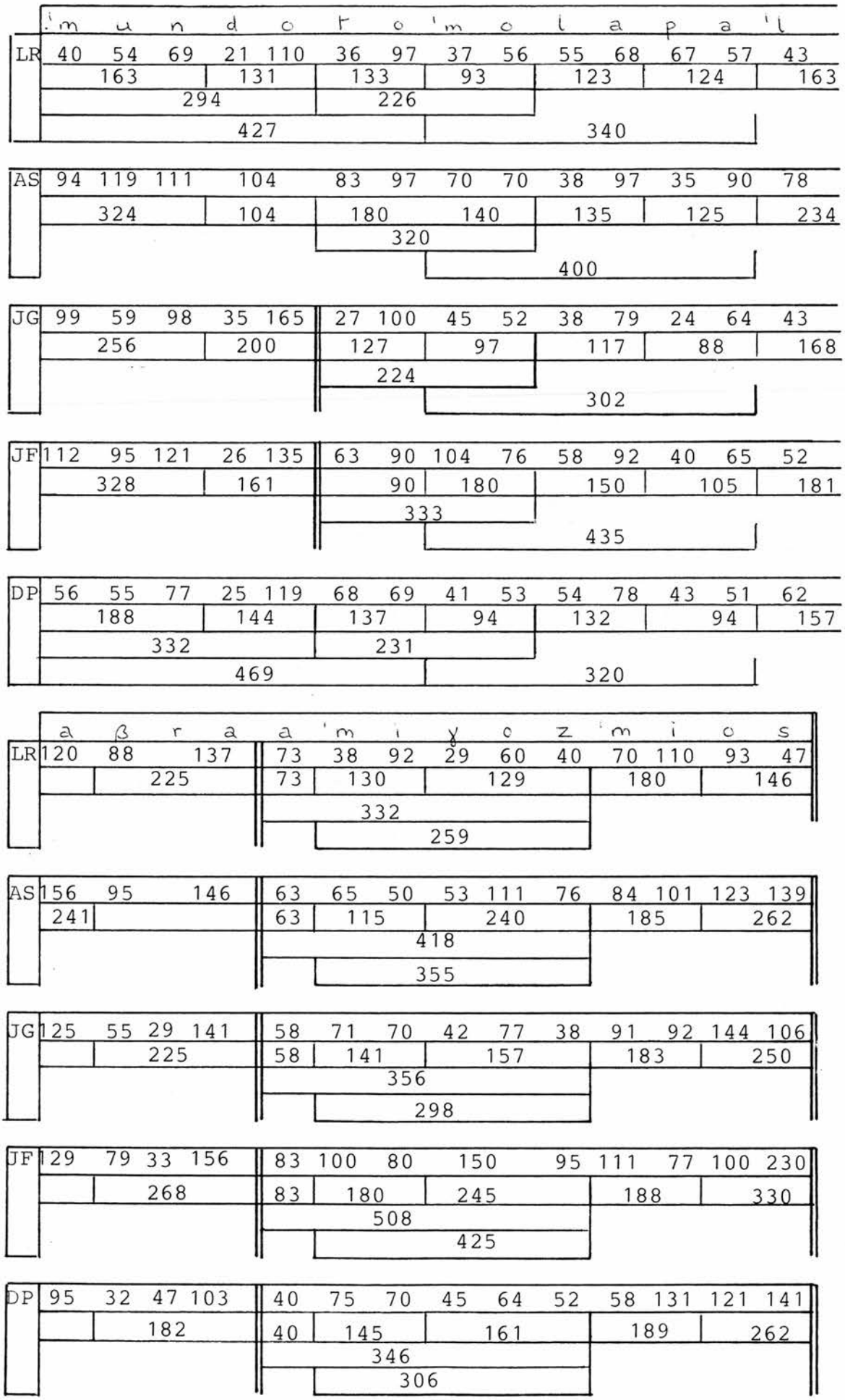
	w	e	n	rr	eu	'n	i	r	a	't	o	ð	e	l
LR	137		87	60	127	43	55	34	83	53	88		101	87
	291			187		132			83	141			188	
				319						412				
	586					215				329				

AS		93	70	102	163	70	59	46	115	38	109		84	57	
		163		265		175			115	147			141		
				603						403					
	680					290				288					

JG	57		90	56	62	43	58	38	113	44	83	32	74		41
	234			118		139			113	127			147		
				257						387					
	497					252				274					

JF	112		87	60	150	83	60	20	132	57	121		185		
	312			210		163			132	178			185		
				373						495					
	732					295				363					

DP	54		106	86	59	45	97	93	85	67	100	89		56	
	260			145		235			85	167		145			
										397					
	545									312					


'm u n d o t o 'm o l a p a 'l
LR 40 54 69 21 110 36 97 37 56 55 68 67 57 43
163 131 133 93 123 124 163
294 226
427 340
AS 94 119 111 104 83 97 70 70 38 97 35 90 78
324 104 180 140 135 125 234
320
400
JG 99 59 98 35 165 27 100 45 52 38 79 24 64 43
256 200 127 97 117 88 168
224
302
JF 112 95 121 26 135 63 90 104 76 58 92 40 65 52
328 161 90 180 150 105 181
333
435
DP 56 55 77 25 119 68 69 41 53 54 78 43 51 62
188 144 137 94 132 94 157
332 231
469 320
a β r a a 'm i y o z 'm i o s
LR 120 88 137 73 38 92 29 60 40 70 110 93 47
225 73 130 129 180 146
332
259
AS 156 95 146 63 65 50 53 111 76 84 101 123 139
241 63 115 240 185 262
418
355
JG 125 55 29 141 58 71 70 42 77 38 91 92 144 106
225 58 141 157 183 250
356
298
JF 129 79 33 156 83 100 80 150 95 111 77 100 230
268 83 180 245 188 330
508
425
DP 95 32 47 103 40 75 70 45 64 52 58 131 121 141
182 40 145 161 189 262
346
306

	s	a	'k	e	m	o	s	e	'x	e	m	p	l	o	
LR	54	106	28	89	53	60	40	80	38	52	82	24	73	60	
	160		117		153			80	172			157			
	430							409							
			350						592						

AS	104	129	46	95	75	230	280	140	110	95	23	62	70		
	233		141		585			140	205		155				
								500							
									585						

JG	38	86	44	87	39	113	32	59	54	72	107	43	37	60	
	124		131		184			59	233			140			
	439							432							
			374						572						

JF	148	89	57	105	80	70	62	95	59	93	106	35	120		
	237		162		212			95	258			155			
	611							508							
			469						623						

DP	108	89	64	80	36	80	42	69	63	66	63	27	35	55	
	197		144		158			69	192			117			
	499							378							
			371						437						

	ð	e	n	o	's	o	t	'r	o	z	'm	i	z	m	
LR	70	58	55	80	55	89	20	61	55	40	90	81	44	70	
	128		135		144		176				215				
					583										
						320									

AS	75	60	90	49	91	40	45	150	60	140	70				
	75	150		140		235			200						
		600							373						
				375					790						

JG	40	46	44	69	32	76	46	51	50	59	78	64	62	85	
	86		113		108		206				204				
			513												
					314										

JF	20	77	33	80	79	82	67	52	90	60	110	93	32	80	
	97		113		161		269				235				
					640										
						430									

DP	59	31	38	37	92	34	57	60	85	62	58	64			
	59	69		129		151			205						
				408											
					280										

	o	s	i	k	o	n	s	e	r	'	β	e	m	o	z
LR	115	50	70	23	67	78	32	60	61		34	59	66	84	
	235		70		168		153				93		150		
			634												
															550

AS	103		64	53	63	82	55	63	37		75	102	53	72	
	173		64		198		155				177		125		
			719												
															630

JG	113	114	79	40	60	81	55	74	36		22	88	84	69	33
	312		79		181		165				110		186		
			721												
															531

JF	118	157	65	60	84	96	61	102	71		50	94	75	107	75
	355		65		240		234				144		257		
			940												
															784

DP	123	85	65	26	99	45	34	53	43		42	68	70	50	60
	272		65		170		130				110		180		
			655												
															550

	n	we	s	t	'	r	a	'	s	a	n	y	'	r	e	'	f	r
LR	75	64	39	36	23	70	76	76	65	25	55	78	123	64				
		178			129			217			158			277				
					682													
								375										

AS	65	95		73	32	63	80	127	47	14	49	66	127	60	
		160			168			254			129			287	
					711										
								383							

JG	31	69	29	21	54	31	29	77	57	26	50	60	90	20	
		129			106			163			136			181	
					534										
								299							

JF	73	98	49	52	111		77	105	93	17	119				
		220			163			275			136				
					794										
								411							

DP	40	75	39	33	43	30	35	62	81		37		67	86	39
		154			106			178				104			196
					542										
								282							

i a k e 'a θ e l l a 'y a r° t

| | | |

	ð	e	l	a	ˈk	o	l	a	p	a	r	a	s	a	
LR	40	55	50	92	43	60	47	81	36	53	34	78	86	66	
	95		142		103		128		89		112		209		
			373						575						
					641										

AS	33	88	57	95	60	103	60	96	37	54	31	89	66	51	
	121		152		163		156		91		120		145		
			471						486						
					675										

JG	53	55	47	84	63	103	40	157	77	78	51	61	77	81	
	108		131		166		197		155		112		241		
			494						671						
					871										

JF	54	90	30	115	58	127	63	112	60	85	35	70	78	162	
	144		145		185		175		145		105		240		
			505						650						
					850										

DP	39	46	51	72	62	95	28	80	79	43	30	63	48	114	
	85		123		157		108		122		93		162		
			388						515						
					642										

	l	ˈβ	a	r	e	l	ˈχ	ˀr	we	s	o	ð	e	s	
LR	57	33	95	37	97	46	15	64	106	84	78		88	58	
		165			143		185			162		88		192	
							490								
		308							627						

AS	28		100		102		83	74	43	103	69	82		89	59
			130		155		220			151		89			
							526								
			285						652						

JG	83	53	82	28		81	36	63	83	50	56	36	69	28	
		163			81		182			106		105			
							369								
		244							565						

JF		37	103	20	70	92	61	67	140	84	74		106	59	
		160			162		268			158		106			
							588								
		322							772						

DP		42	66	30	114		47		96	40	45	40	65	49	
		138			114		143			85		105			
							342								
		252							532						

	u	s	ˈf	we	rˌ	θ	a	s	ˈg	ˌr	a	n	l	e
LR	82	104	89	47	107	131	128		78	67	85	71	39	88
	192		188		366				301				159	
									301					
									460					
AS	74	118	119	84	93	134	189		76	71	128	41	75	85
	192		262		416				316				204	
									316					
									520					
JG	84	60	62	80	45	107	120	133	34	51	69	99	43	49
	172		187		360				253				123	
									253					
									376					
JF	110	142	112	71	110	130	193		66	62	132	108	46	82
	240		254		433				368				193	
									368					
									561					
DP	97	53	54	63	42	54	129	252	36	52	82	90	22	36
	199		159		435				260				103	
									260					
									363					

	k	ˈθ	jc	n	ˈn	c	t	e	ˈn	e	m	c	z	ˈm
LR	32	100	89	215	67	48	25	43	24	58	65	85		88
		404			115		68		82		150			155
					115		300							
					183				232					
AS	44	155	190	175	54	130	28	92	50	110	75	75	41	58
		520			184		120		160		191			149
					184		471							
					304				351					
JG	31	90	140	191	47	100	43	60	45	92	85	78	73	80
		421			147		103		137		236			162
					147		476							
					250				373					
JF	65	148	146	190	93	112	45	59	76	78	66	99	81	86
		484			205		104		154		246			181
					205		504							
					309				400					
DP	45	50	154	115	26	104	23	47	58	62	70	73	15	59
		319			130		70		120		158			140
					130		348							
					200				278					

	u	tʃ	o	z	ð	e	n	o	ˈs	o	t	ʳr	o	s
LR	67	68	97	26	27	37	55	75	60	74	65	35	49	29
		191			64		130		134		178			
	346				506									
	540								312					
AS	91	51	89	48	57		43	92	74	146	30	55	65	20
		188			57		135		220		170			
	337				582									
	529								390					
JG	82	55	60	30	25	48	47	84	60	91	52	61	130	112
		145			73		131		151		355			
	307													
	511													
JF	95	100	118	21	21	75	57	90	86	112	65	71	79	88
		239			96		147		198		303			
	420				744									
	663								501					
DP	81	80	56	36	39	47	54	52	67	106	36	55	104	84
		172			86		106		173		279			
	312													
	504													

	ˈp	a	ʳ	t	e	z	ð	e	l	ˈk	we	ʳ	p	o
LR	80	68	57	51	84	35	36	125		70	80	65	47	83
	205			170			161			215			130	
	375						506							
	536									448				
AS	95	107	68	45	100	25	25	40	45	77	120	73	53	82
	270			170			110			270			135	
	440						515							
	550									526				
JG	130	86	69	75	90	51	23	44	36	59	88	96	54	114
	285			216			103			243			168	
	501						514							
	604									527				
JF	100	92	73	67	109	38	33	41	79	70	136	64	80	100
	265			214			153			270			180	
	479						603							
	632									605				
DP	47	84	53	34	53	35	34	51	80	48	62	70	60	90
	184			122			165			180			150	
	306						495							
	471									437				

	k	e	ˈp	we	ð	a	n	ˈs	e	rˀ	s	a	k	ˀr
LR	40	63	67	70	40	82	64	77	60	37	71	52	47	63
	103		137		186			174			123		147	
			426					174						
				323						569				
AS	29	92	74	100	60		76	44	44	91	34	91	48	22
	121		174		136			179			125		135	
			431					179						
				310						592				
JG	35	81	49	85	43	89	32	61	85	45	70	45	25	75
	116		134		164			191			115		138	
			414					191						
				298						561				
JF	60	95	35	131	34	68	71	94	80	56	96	78	36	55
	155		166		173			230			174		148	
								230						
										698				
DP	40	67	48	65	29	58	57	69	99		40	104	53	44
	107		113		144			168			144		156	
			364					168						
				257						590				

	i	f	i	ˈk	a	ð	c	s	p	ˀr	i	ˈm	e	r
LR	37	72	53	40	83	62	120	70	90	45	52	71	80	29
		125		123		252			187			151		162
				770								500		
						562								
AS	65	63	90	97	110		119	29	83	68	56	64	106	37
		153		207		148			207			170		125
		768										502		
						562								557
JG	38	40	77	50	80	50	80	80	55	33	57	55	80	33
		117		130		210			145			135		145
		710												
						485								
JF	57	80	66	69	127	39	126	165	56	55	63	87	79	34
		146		196		330			174			166		127
												467		
														638
DP	59	43	79	35	71	39	90	60	70	70	34	56	77	32
		122		106		189			174			133		120
		717										427		
							469							591

o p o r° k e 'n o 't je n e n u

LR	133	45	60	109	46	70	52	88	30	75	47	95	63	42					
		214			116		140		105			205			125				
			470							310									
		643					140					561							

AS	88	32	57	66	40	67	36	100	67	80	51	49	91	49					
		155			107		136		147			191			149				
			398							338									
							136					580							

JG	112	48	84	86	67	60	39	91	33	104	49	52	71	23					
		218			127		130		137			172			97				
			475							309									
							130					496							

JF	93	52	92	88	55	58	57	98	65	104	50	76	70	84					
		232			113		155		169			196			140				
			500							365									
							155					619							

DP	88	71	56	39	30	42	50	70	64	48	51	44	93	53					
		166			72		120		112			188			129				
			358																
							120												

m ß i 't a l i n t e 'r e s p

LR	83	30	96	26	121	48	64	84	23	77	30	94	44	75					
		126			195		148		100			168			125				
			446							416									
					443									513					

AS	100	93		62	89	67	43	80	44	63	35	111	33	60					
		93			218		123		107			179			125				
			460							409									
					448									559					

JG	74	25	65	40	65	48	51	80	38	70	35	107	66	45					
		90			153		131		108			208			104				
			340							447									
					392									518					

JF	56	33	81	67	94	45	69	99	47	104	34	123	52	57					
		114			206		168		151			209			141				
			460							528									
					525									580					

DP	76	26	88	33	70	49	39	92	23	64	34	106	40	60					
		114			152		131		87			180			95				
			395							398									
					370									460					

a r a n o ˈs o t ˀr o s p o rˀ

LR	50	34	63	53	70	57	95	49	59	65	125	55	62	54								
		97		123		152		233				171										
														283								

AS	65	32	80	53	90	80	150	45	48	94	83	50	87	75								
		112		143		230		270				212										
														375								

JG	59	25	48	64	69	47	80	43	51	93	150	48	68	75								
		73		133		127		337				191										
														335								

JF	84	74		59	97	107	105	50	60	105	120	56	90	100								
		74		156		212		335				246										
														396								

DP	35	27	56	47	55	50	85	55	55	74	194	47	59	51								
		83		102		135		378				157										
														272								

ˈk e l a rˀˈǯ i ʎ a ˈt je n u n

LR	47	65	60	57	53	42	66	94	88	25	77	38	60	40								
	112		170			108		182		102		98		140								
						460						340										
			282					290				340										

AS	65	98	67	70	47	31	97	43	74	44	120			35								
	163		154			128		117		164				136								
						399						300										
			317					245				300										

JG	59	85	46	100	40	70	75	90	130	49	107			52	67							
	144		186			145		220		208	162											
						551						370										
			330					365				370										

JF	55	95	57	121	49	81	71	60	110	85	122	77	141	75								
	150		227			152		170		207		218		190								
						549						615										
			377					322				615										

DP	64	51	58	69	58	30	52	58	72	38	60	56	72	36								
	115		185			82		130		98		128		132								
						397						358										
			300					212				358										

a ˈk o l a ˈk a s i t a ŋ ˈy ˀr

LR	100		30	67	40	63	55		65	79	45	45	70		87	18	68							
			97		103		120			124			202				263							
			200				244										565							
			200				446																	
AS	101		62	68	33	83	41		90	51	72	42	93		87	9	41							
			130		116		131			123			222				203							
			246				254										522							
			246				476																	
JG	95		54	99	51	90	60		117	60	77	32	65		61	18	58							
			153		141		177			137			158				232							
			294				314										486							
			294				472																	
JF	115		75	98	66	102	74		145	92	61	62	90		123	67								
			173		168		219			153			275				267							
			341				372										612							
			341				647																	
DP	96		40	40	31	85	73		48	23	73	24	63		103	37	27							
			80		116		121			96			190				180							
			196				217										484							
			196				407																	

a n ə e k o ˈm we ʎ a i k e l

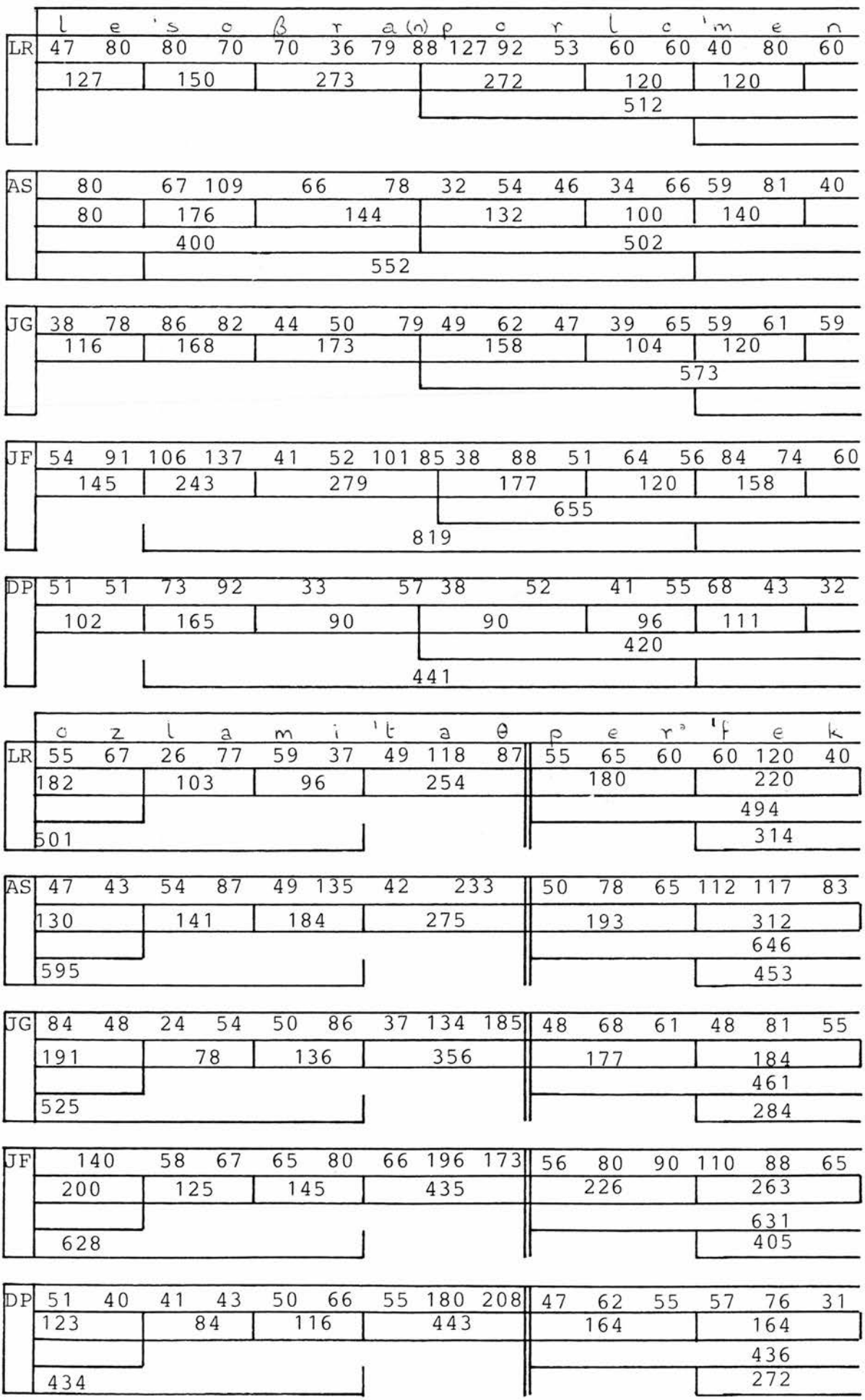
LR	57	120		13	87	33	67	50	164	126	150		88	52	53	47								
			100			100		214			276		88		105		131							
																	668							
			463																					
AS	70	83		97		34	40	91	117		72		86	50	51	59								
			97			74		208			72		86		101		162							
						354											676							
			374					629																
JG	77	79		30	66	40	80	66	157	92	170		79	50	49	51								
			96			120		223			262		79		99		131							
																	599							
			448																					
JF	104	96		70		60	94	75	105	88	72	210	77	73	83	49								
			70			154		180		88		282	77		156		162							
																	755							
			491																					
DP	59	57		30	84	60	58	80	73	79	163		84	68	40	52								
			114			118		153			242		84		108		125							
																	581							
			412																					

	e	's	i	ɣ	e	k	o	m	(i)u	ŋ	k	a	s	't	i	
LR	84	104	69	38	133	44	98	38	77	123	28	89	61	43	147	
		173		171		142		238			178			190		
AS	103	112	91	57	67	41	65	116		58	30	70	90	102	120	
		203		124		106		174			190			222		
JG	80	83	60	49	98	30	45	60		65	45	80	55	55	80	
		143		147		75		125			180			135		
JF	113	111	105	55	89	56	80	68	157	85	37	143	83	67	160	
		216		144		136		310			263			227		
DP	73	80	60	37	87	26	38	35	47	47	55	85	58	55	65	
		140		124		64		129			198			120		

	ɣ	o	k	e	'a	ɛ	e	l	a	k	o	'ŋ	i	n	a
LR	175		39	107	127	73	44	46	95	24	81	77	78	35	50
	175		146		127	117		141		105		155		85	
				390					486						
					490								437		
AS	158		48	55	118	38	54	51	90	32	88	115	70	50	80
	158		103		118	92		141		120		185		130	
				313					576						
					471								498		
JG	55	113	45	82	120	73	57	37	90	32	81	93	88	61	105
	168		127		120	130		127		113		181		166	
				377					587						
					490								495		
JF	40	150	55	137	123	73	57	63	77	50	90	123	77	63	80
	190		192		123	130		140		140		200		143	
				445					623						
					533								550		
DP	33	152	44		109	65	39	49	75	42	75	85	42	36	106
	185		153			104		124		117		127		142	
				257					510						
					498								437		

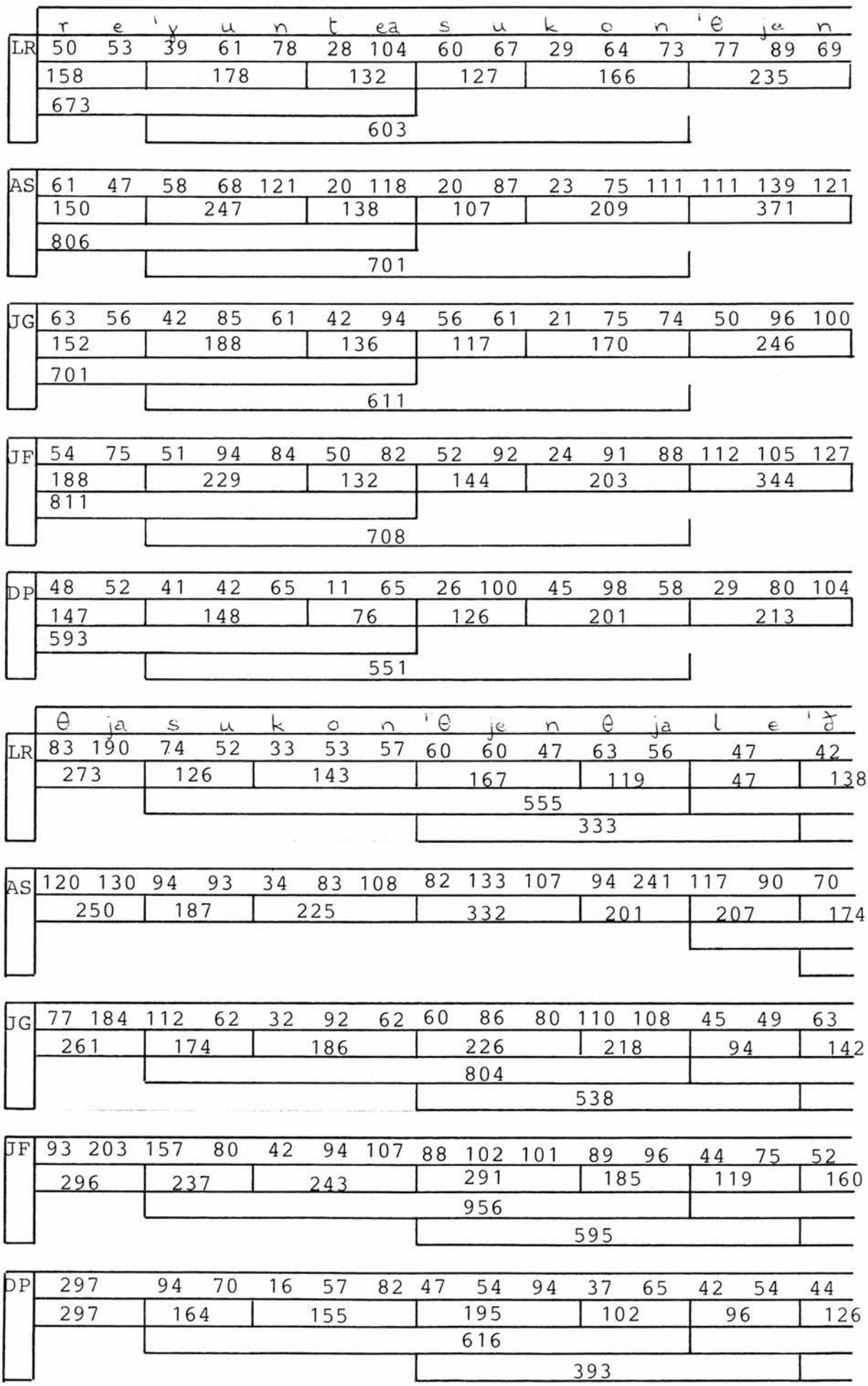
	k	o	n	'ɪ	t	a	n	t	a	z	'm	a	m	a	s	e
LR	50	55	92	18	70	94	32	60	52	97	99	68		175		57
		197			182			144			196			243		83
						523										
						326										
AS	62	53	68	41	86	90	40	50	60	100	125	79		97	127	101
		183			217			150			225			303		101
						550										
						367										
JG	33	40	75	40	70	75	35	85	48	58	92	54		98	194	97
		148			185			168			150			346		163
						501										
						353										
JF	47	70	90	50	100	90	48	102	50	103	112	60		131	172	100
		207			240			200			215			363		154
						647										
						440										
DP	50	45	73	33	55	80	33	55	62	59	81	73		117	250	62
		168			168			150			140			440		100
						486										
						318										

	s	'ɪ	a	'm	ui	s	e	'ɣ	u	ɾ	a(če)	k	e	'n	o
LR	26	28	76	76	125	88	83	32	79	40	87	70	56	44	55	63
		104		201		171		111		127		70	100		118	
	187			201				409								
		104		372						408						
AS		91	89	64	102	63	91	23	113	30	160	44	61	69	84	
		180		166		154		136		190		105		153		
	281			166				480					258			
		180		320						431					233	
JG	66	26	92	78	132	87	93	55	69	32	140	64	84	56	42	
		118		210		180		124		172		148		98		
	281			210				476								
		118		390												
JF	54	61	95	72	110	107	83	38	117	30	111	41	73	70	73	
		156		182		190		155		141		114		143		
	310			182				486								
		156		372												
DP	38	54	71	62	76	50	60	34	80	40	89	37	43	48	62	
		125		138		110		114		129		80				
	225			138				353								
		125		248												


l e 's o ß r a(n) p c r l c 'm e n
LR 47 80 80 70 70 36 79 88 127 92 53 60 60 40 80 60
127 150 273 272 120 120
512
AS 80 67 109 66 78 32 54 46 34 66 59 81 40
80 176 144 132 100 140
400 502
552
JG 38 78 86 82 44 50 79 49 62 47 39 65 59 61 59
116 168 173 158 104 120
573
JF 54 91 106 137 41 52 101 85 38 88 51 64 56 84 74 60
145 243 279 177 120 158
655
819
DP 51 51 73 92 33 57 38 52 41 55 68 43 32
102 165 90 90 96 111
420
441
o z l a m i 't a θ p e r° 'f e k
LR 55 67 26 77 59 37 49 118 87 55 65 60 60 120 40
182 103 96 254 180 220
494
501 314
AS 47 43 54 87 49 135 42 233 50 78 65 112 117 83
130 141 184 275 193 312
646
595 453
JG 84 48 24 54 50 86 37 134 185 48 68 61 48 81 55
191 78 136 356 177 184
461
525 284
JF 140 58 67 65 80 66 196 173 56 80 90 110 88 65
200 125 145 435 226 263
631
628 405
DP 51 40 41 43 50 66 55 180 208 47 62 55 57 76 31
123 84 116 443 164 164
436
434 272

t a 'm e n t e s e 'y u r a 'ǯ i

| | | |


r e 'y u n t ea s u k o n 'e je n
LR 50 53 39 61 78 28 104 60 67 29 64 73 77 89 69
158 178 132 127 166 235
673 603
AS 61 47 58 68 121 20 118 20 87 23 75 111 111 139 121
150 247 138 107 209 371
806 701
JG 63 56 42 85 61 42 94 56 61 21 75 74 50 96 100
152 188 136 117 170 246
701 611
JF 54 75 51 94 84 50 82 52 92 24 91 88 112 105 127
188 229 132 144 203 344
811 708
DP 48 52 41 42 65 11 65 26 100 45 98 58 29 80 104
147 148 76 126 201 213
593 551
e ja s u k o n 'e je n e ja l e 'ɜ
LR 83 190 74 52 33 53 57 60 60 47 63 56 47 42
273 126 143 167 119 47 138
555 333
AS 120 130 94 93 34 83 108 82 133 107 94 241 117 90 70
250 187 225 332 201 207 174
JG 77 184 112 62 32 92 62 60 86 80 110 108 45 49 63
261 174 186 226 218 94 142
804 538
JF 93 203 157 80 42 94 107 88 102 101 89 96 44 75 52
296 237 243 291 185 119 160
956 595
DP 297 94 70 16 57 82 47 54 94 37 65 42 54 44
297 164 155 195 102 96 126
616 393

e x a ß s o 'l u t a 'm e n t e

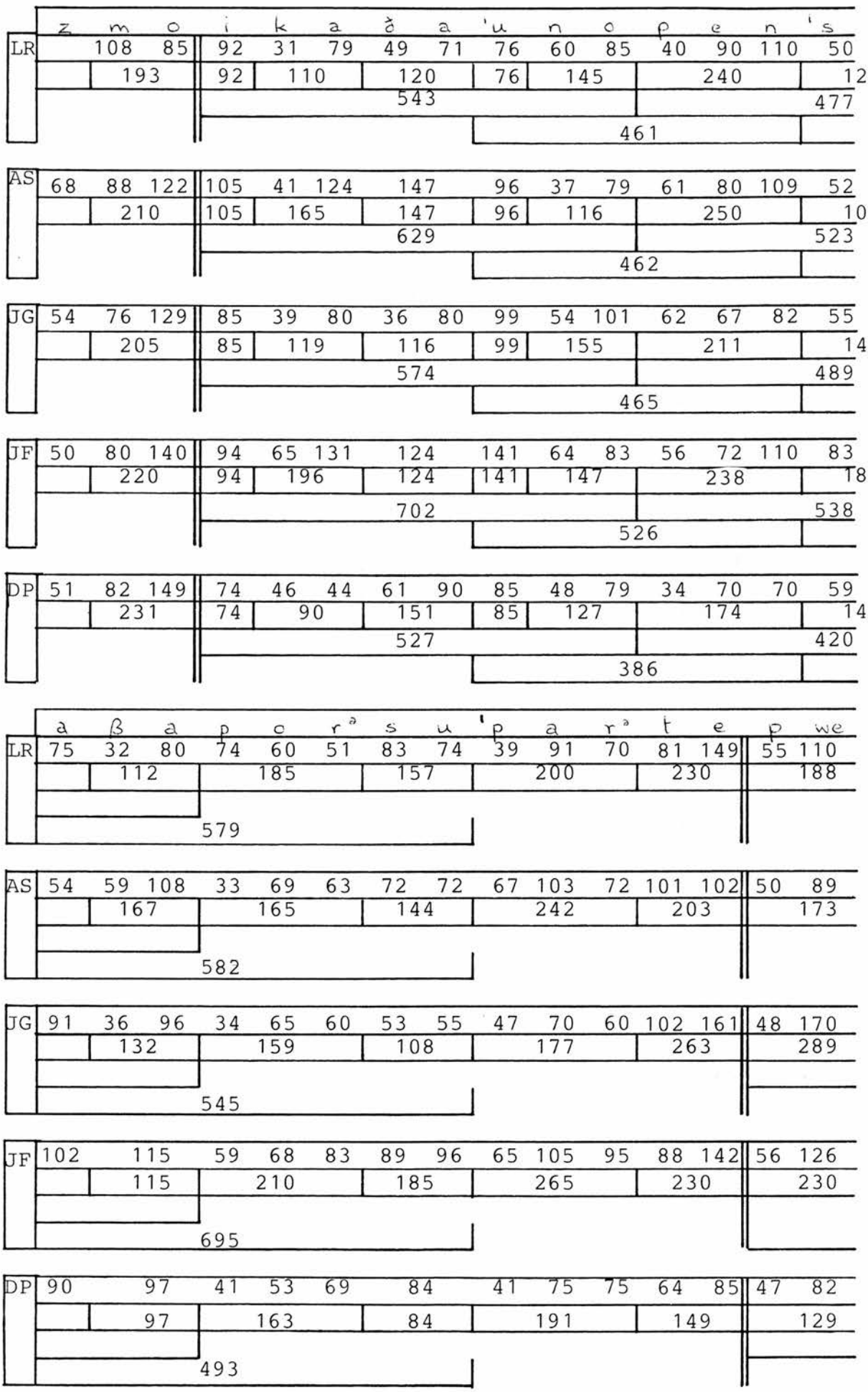
LR	96	59	98	85	58	43	22	82	19	59	49	64	48	41	83	
		242			101		104		78		161			124		
	427				283						285					
	481						182						495			
AS	104	66	105	68	101	58	59	102	27	81	63	78	68	23	82	
		239			159		161		108		209			105		
	620				428						314					
	572						269						569			
JG	79	87	85	29	79	34	37	85	39	51	65	68	72	25	65	
		201			113		122		90		205			90		
	437				325						295					
	456						212						499			
JF	108	65	98	42	120	68	62	87	53	80	66	94	93	44	83	
		205			188		149		133		253			127		
	484				470						380					
	553						282						635			
DP	82	55	44	30	26	62	35	31	22	65	41	29	40	15	75	
		129			88		66		87		110			90		
	351				241						200					
	343						153						397			

t 'r a n 'k i l a 'e s o l o ß e

LR	30	50	52	78	45	89	46	187	95	33	47	57	50	46	59	
	210				134		233		95	80		107		105		
									175							
									387							
AS	35	40	53	127	70	95	25	130	141	62	70	50	65	62	83	
	255				165		155		141	132						
									273							
									533							
JG	39	28	54	83	76	60	87	133	121	94	55	42	59	40	59	
	204				136		220		121	149		101		99		
									270							
									470							
JF	31	63	54	107	49	146	72	146	140	70	73	51	65	49	86	
	255				195		218		140	143		116		135		
									283							
									534							
DP	23	57	38	79	46	66	147		83	25	74	43	63	50	50	
	197				112		147		83	99		106		100		
									182							
									388							

	ˈ	r	e	m	o	z	ˈǒ	i	x	we	l	l	e	ˈo	n	s	
LR	31	76	87	135	67	35	80	92	68	65	63	64	83	108	107		
	107		289			115		225			127		191			188	
	608					340					318						
	396					467							474				
AS	20	107	88	85		56	39	70	95	55	55	85	92	113	84		
	127		173			95		220			140		205			162	
	560					315					345						
	300					455							485				
JG	43	70	95	121	203	35	102	93	92	49	49	62	124	164	140		
	113		419			137		234			111		288			195	
						371					399						
						482							586				
JF	41	86	94	115	160	140	105	79	98	44	44	100	85	190	115		
	127		369			245		221			144		275			209	
						466					419						
						610							617				
DP	40	73	59	118	55	48	60	97	64	33	33	57	81	186	124		
	113		232			108		194			90		267			199	
	551					302											
	345					392											

	e	y	u	ˈr	i	s	i	m	o	ò	e	s	i	ˈm	i	
LR	81	37	58	50	48	123	45	50	54	40	74	75	54	71		80
		95		98		168		104		114		129			151	
		653														
				613												
AS	78	68	50	41	96	79	78	45	81	88		91	76	66		119
		118		137		157		126		88		167			253	
		700														
				675												
JG	55	47	56	40	88	107	45	60	60	35	65	87	30	71	97	
		103		128		152		120		100		117			222	
		698														
				617												
JF	94	74	59	42	97	69	56	54	88	117		95	45	85	95	
		133		139		125		142		117		140			230	
		748														
				663												
DP	75	35	49	44	68	52	55	53	61	32	59	46	67	65	75	
		84		112		107		114		91		113			191	
		616														
				537												


z m o i k a ž a 'u n o p e n 's
LR 108 85 92 31 79 49 71 76 60 85 40 90 110 50
193 92 110 120 76 145 240 125
543 477
461
AS 68 88 122 105 41 124 147 96 37 79 61 80 109 52
210 105 165 147 96 116 250 106
629 523
462
JG 54 76 129 85 39 80 36 80 99 54 101 62 67 82 55
205 85 119 116 99 155 211 146
574 489
465
JF 50 80 140 94 65 131 124 141 64 83 56 72 110 83
220 94 196 124 141 147 238 185
702 538
526
DP 51 82 149 74 46 44 61 90 85 48 79 34 70 70 59
231 74 90 151 85 127 174 149
527 420
386
a ß a p o r a s u 'p a r a t e p we
LR 75 32 80 74 60 51 83 74 39 91 70 81 149 55 110
112 185 157 200 230 188
579
AS 54 59 108 33 69 63 72 72 67 103 72 101 102 50 89
167 165 144 242 203 173
582
JG 91 36 96 34 65 60 53 55 47 70 60 102 161 48 170
132 159 108 177 263 289
545
JF 102 115 59 68 83 89 96 65 105 95 88 142 56 126
115 210 185 265 230 230
695
DP 90 97 41 53 69 84 41 75 75 64 85 47 82
97 163 84 191 149 129
493

	z	'	j	o	n	o	'	t	e	ŋ	ɣ	wa	ß	s	o	'	l	u
LR	23		100		47	70		43	80	50	18	132	51	100		66	31	89
		100			117			173			201			166			120	
						491											386	
								540										220

AS	34	29	63	31	102	48	69	105	18	89	24	117	64	46	109				
		92		133		222			131			181		155					
					486									468					
							534								287				

JG	71	162		70	92	40	104	73	27	95	44	76	42	44	66				
		162		162		217			166			118		110					
	451				545									314					
			324					501							196				

JF	48	49	86	44	103	65	78	93	21	100	53	112	52	64	87				
		135		147		236			174			164		151					
	365				557									432					
			282					574							268				

DP		56	52	52	80	36	59	60	26	69	29	28	31	32	35				
		108		132		155			124			59		67					
	237				411									210					
			240					338							151				

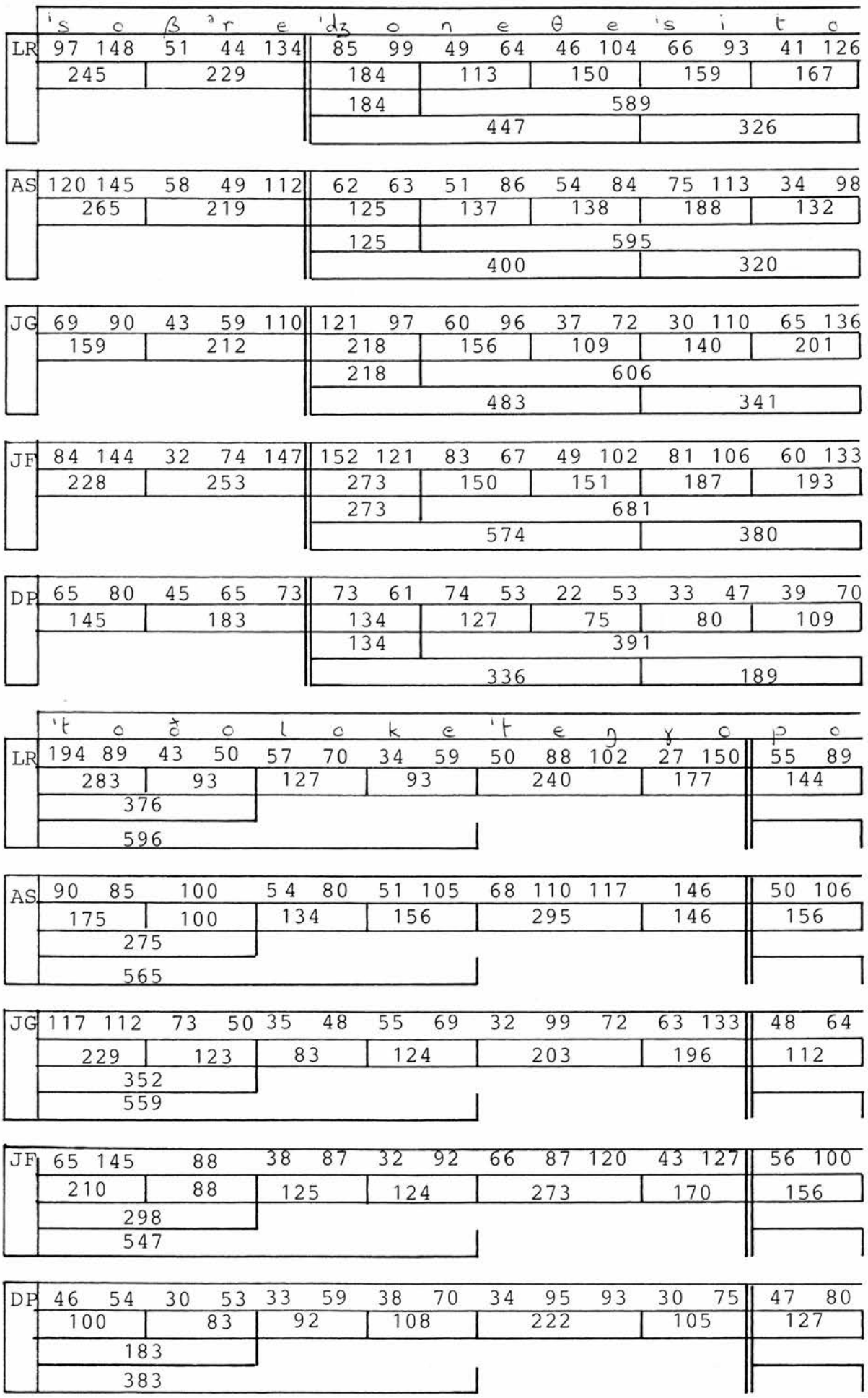
	t	a	'm	e	n	t	e	'n	a	ă	a	k	e	m	e
LR	20	80	56	48	98	53	65	30	94	37	78	30	40	46	52
	100		202			118		124		115		70		98	
				320					239						
				320						407					

AS	53	79	56	66	107	29	77	74	87	120		60	48	61	74
	132		229			106		161		120		108		135	
				335					281						
				335						524					

JG	34	52	47	77	72	45	70	33	100	48	92	43	52	55	68
	86		196			115		133		140		95		123	
				311					273						
				311						491					

JF	45	72	58	78	82	41	89	59	126	39	99	48	73	56	87
	117		218			130		185		138		121		143	
				348					323						
				348						587					

DP	43	41	46	47	53	41	39	52	72	36	68	27	47	65	60
	84		146			80		124		104		74		125	
				226					228						
				226						427					


ˈs o β ˈa r e ˈʤ o n e θ e ˈs i t o
LR 97 148 51 44 134 85 99 49 64 46 104 66 93 41 126
245 229 184 113 150 159 167
184 589
447 326
AS 120 145 58 49 112 62 63 51 86 54 84 75 113 34 98
265 219 125 137 138 188 132
125 595
400 320
JG 69 90 43 59 110 121 97 60 96 37 72 30 110 65 136
159 212 218 156 109 140 201
218 606
483 341
JF 84 144 32 74 147 152 121 83 67 49 102 81 106 60 133
228 253 273 150 151 187 193
273 681
574 380
DP 65 80 45 65 73 73 61 74 53 22 53 33 47 39 70
145 183 134 127 75 80 109
134 391
336 189
ˈt o ð o l o k e ˈt e ŋ ɣ o p o
LR 194 89 43 50 57 70 34 59 50 88 102 27 150 55 89
283 93 127 93 240 177 144
376
596
AS 90 85 100 54 80 51 105 68 110 117 146 50 106
175 100 134 156 295 146 156
275
565
JG 117 112 73 50 35 48 55 69 32 99 72 63 133 48 64
229 123 83 124 203 196 112
352
559
JF 65 145 88 38 87 32 92 66 87 120 43 127 56 100
210 88 125 124 273 170 156
298
547
DP 46 54 30 53 33 59 38 70 34 95 93 30 75 47 80
100 83 92 108 222 105 127
183
383

ˈɣ ˀr i a m c s e ŋ k c n ˈt ˀr a

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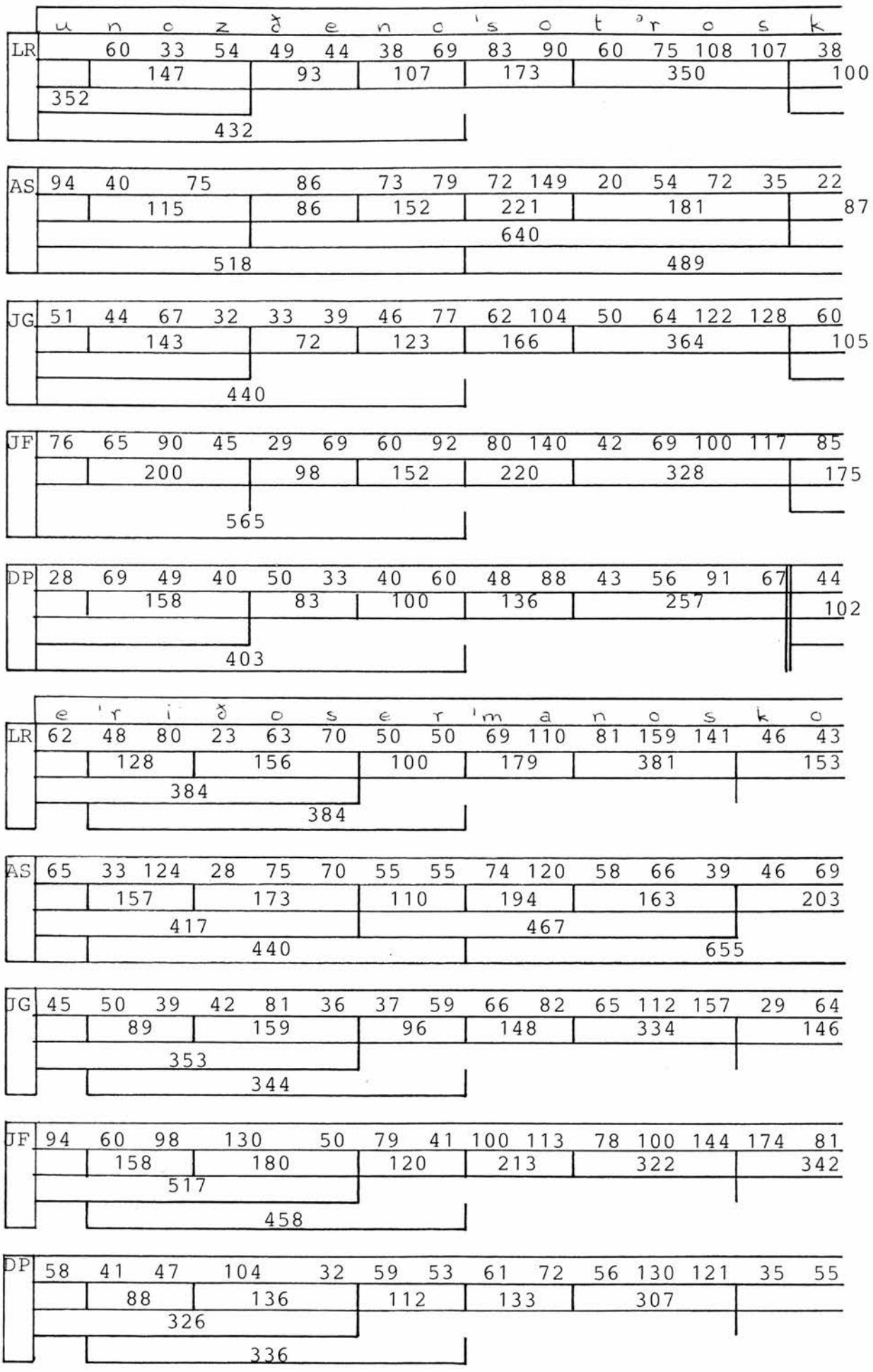

u n o z ž e n o 's o t 'r o s k
LR 60 33 54 49 44 38 69 83 90 60 75 108 107 38
147 93 107 173 350 100
352
432
AS 94 40 75 86 73 79 72 149 20 54 72 35 22
115 86 152 221 181 87
640
518 489
JG 51 44 67 32 33 39 46 77 62 104 50 64 122 128 60
143 72 123 166 364 105
440
JF 76 65 90 45 29 69 60 92 80 140 42 69 100 117 85
200 98 152 220 328 175
565
DP 28 69 49 40 50 33 40 60 48 88 43 56 91 67 44
158 83 100 136 257 102
403
e 'r i ž o s e r 'm a n o s k o
LR 62 48 80 23 63 70 50 50 69 110 81 159 141 46 43
128 156 100 179 381 153
384
384
AS 65 33 124 28 75 70 55 55 74 120 58 66 39 46 69
157 173 110 194 163 203
417 467
440 655
JG 45 50 39 42 81 36 37 59 66 82 65 112 157 29 64
89 159 96 148 334 146
353
344
JF 94 60 98 130 50 79 41 100 113 78 100 144 174 81
158 180 120 213 322 342
517
458
DP 58 41 47 104 32 59 53 61 72 56 130 121 35 55
88 136 112 133 307
326
336

n t i 'n wo e l l e 'o n 'u n a c 'ǰ o z

LR	64	35	74							69	76	137		70	130		68
		109								69	213				268		
											282				268		
											282				268		

AS	88	22	73	72						120	49	97		72	89		30
		95								120	146				191		
											266				191		
											266				191		

JG	53	40	52	38						130	55	149		75	49	99	60
		92								130	204			75	208		
															283		
															283		

JF	87	38	65	60						149	77	180		56	128		74
		163								149	257				258		
											406				258		
											406				258		

DP	72	23								110	46	93		63	65		56
										110	139				184		
											249				184		
											249				184		

'l i β °r a z ð e 'k a r° n e k e

LR	59	98	61	34	67	70	36	95	36	79	37	133	134	83															
	157		232				131		152			267		83															
			389						550						217														
					520							502																	

AS	36	97	60	95	17	18	57	48	105	34	84	84	22	63															
	133		172			75		187			168		85																
			305					430						185															
			380						440																				

UG	72	63	42	63	70	31	37	83	40	89	75	107	185	55	95														
	135		206			120		204			292			150															
		341																											
				461																									

JF	74	113	34	45	94	36	130		56	120	52	80	105	48	92														
	187		209			130		228			185		140																
		396					543							308															
				526						553																			

DP	79	73	30	27	50	18	23	100	48	92	40	82	90	40	55														
	152		125			123		180			172		95																
		277					475							180															
				400						447																			

	'n	o	n	o	s	's	o	n	i	n	d	i	s	p	e
LR	69	65	52	68	68	69	74	64	51	90	18	49	66	72	69
	134			188			207			141		133			222
					395										
			322								703				

AS	52	48	70	88	31	31	58	75	58	70	20	70	20	80	60
	100			189			164			128		110			220
					353										
			289								622				

JG	64	56	45	80	45	45	76	74	38	42		80	50	43	50
	120			170			195			80		130			165
	270				365										
			290								730				

JF	73	95	67	110	50	50	105	70	64	70	23	73	62	64	59
	168			227			225			134		158			230
					452										
			395								747				

DP	45	40	48	64	26	26	86	52	62	46	26	68	55	20	26
	85			138			164			108		149			146
					302										
			223								567				

	n	's	a	ß	l	e	s	i	't	u	p	o	r	'k	e	't	je
LR	81	84						89	34	180	65	84	65	30	73	30	107
								89	214		214			103		110	
									303			317					
										428				103			

AS	80	80						140	99	197	167	78	65	37	84	31	75
								140	296		310			121		106	
									436			431					
										606				121			

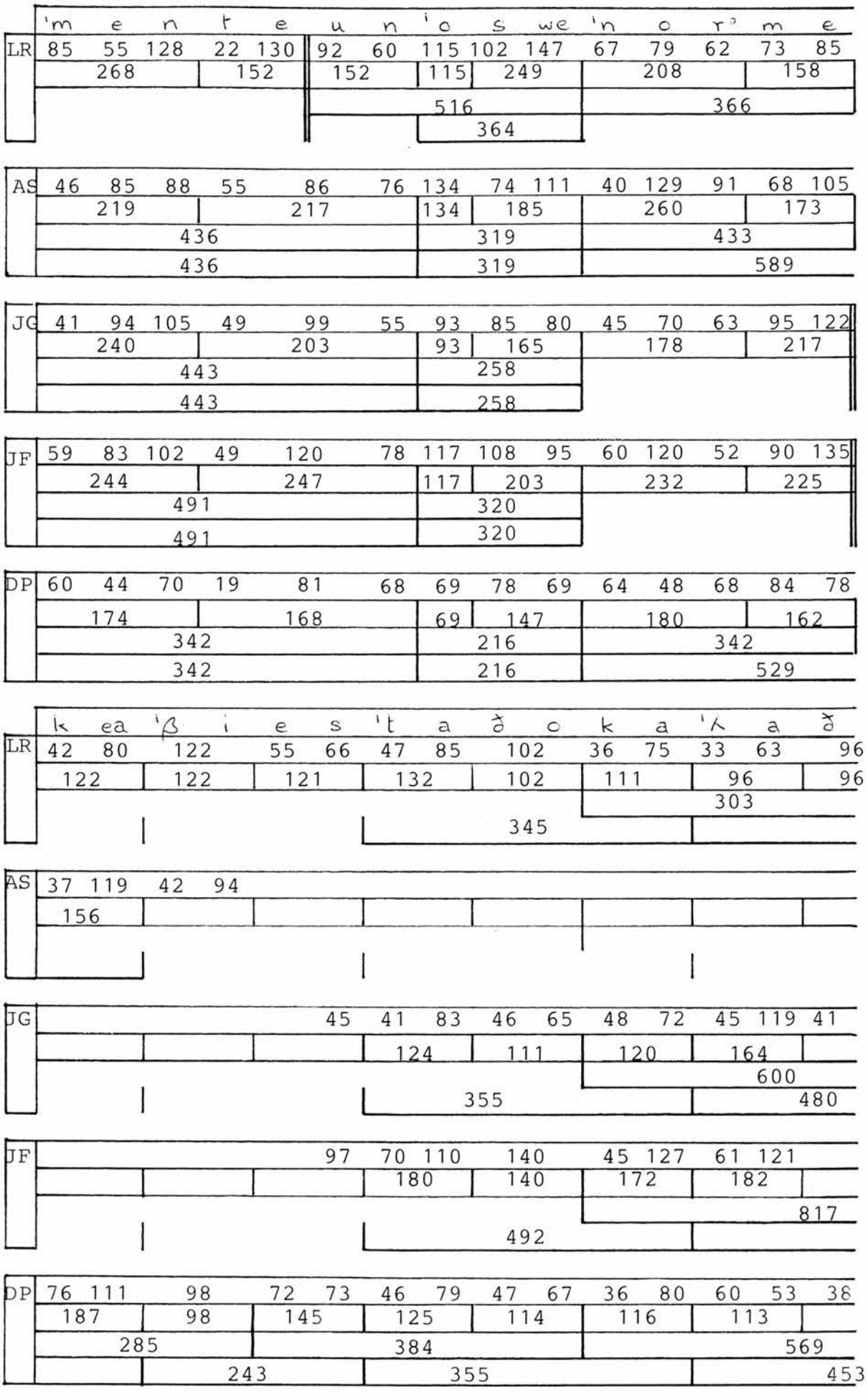
JG	72	67						126	60	250	48	74	82	28	69	48	115
								126	310			204		97		163	
													301				
														97			

JF	107	61						127	86	214	56	95	76	55	138	30	91
								127	300			227		193		121	
													420				
														193			

DP	100	31						94	52	170	47	70	47	24	78	59	80
								94	222			164		102		139	
													266				
														102			

n e z l a k a 'ß e e a t a g 'y

| | | |


'm e n t e u n 'o s we 'n o r' m e
LR 85 55 128 22 130 92 60 115 102 147 67 79 62 73 85
268 152 152 115 249 208 158
516 366
364
AS 46 85 88 55 86 76 134 74 111 40 129 91 68 105
219 217 134 185 260 173
436 319 433
436 319 589
JG 41 94 105 49 99 55 93 85 80 45 70 63 95 122
240 203 93 165 178 217
443 258
443 258
JF 59 83 102 49 120 78 117 108 95 60 120 52 90 135
244 247 117 203 232 225
491 320
491 320
DP 60 44 70 19 81 68 69 78 69 64 48 68 84 78
174 168 69 147 180 162
342 216 342
342 216 529
k ea 'β i e s 't a ð o k a 'ʌ a ð
LR 42 80 122 55 66 47 85 102 36 75 33 63 96
122 122 121 132 102 111 96 96
303
345
AS 37 119 42 94
156
JG 45 41 83 46 65 48 72 45 119 41
124 111 120 164
600
355 480
JF 97 70 110 140 45 127 61 121
180 140 172 182
817
492
DP 76 111 98 72 73 46 79 47 67 36 80 60 53 38
187 98 145 125 114 116 113
285 384 569
243 355 453

w a s t e n 't o n θ e s e z 'm

LR		96	39	33	107	61	51	103	119		259			72		53							
		135			201			273			259			72		137							
														209									
		528																					

AS				75	73	112	40	122	118	83	92	50				100							
				270			280			225				72		165							
														237									

JG		75	44	31	47	78	32	67	77	87	92	168		173		100							
		160			156			176			347			173		173							
														346									

JF		128	77	68	89	101	64	80	118	77	115			139	56	84							
		205			258			262						195		203							
														398									
		645																					

AS		84	40	25	67	86	22	80	80	60	45			40	55	65							
		162			178									95		111							
														206									

ui n e θ e 's a r jo k e 'j o 't e

LR	84	42	63	54	75	37	79	34	136	35	49	64	86	29	63								
		105		129		116		170		84		150			134								
				520						234													
		371				370						150											

AS	65	57	85	58	87	72	125	34	133	37	74	45	97	51	68								
		142		145		197		167		111		142			181								
				651						253													
		452				475						142											

JG	73	55	60	56	86	70	108	42	83	123	78	79	39	122	35	120							
		115		142		178		125		123	157		161			213							
				683							318												
		430				583						161											

JF	119	79	80	62	110	65	150	30	177	56	92	35	105	86	89								
		159		172		215		207		148		140			272								
				753						288													
		534				570						140											

DP	46	54	61	34	80	60	70	40	88	44	48	109		28	48								
		115		114		130		128		92		109			167								
				487						201													
		340				350						109											

ŋ g a β a s 'ţ a n ţ e s 'p a θ

LR	42	20	70	107		48	35	65	120	121	213		91	86	110		100		
		90			155			220			425				196			238	
	224															434			
				379															

AS	62	20	54	21	43	62	70	90	74	6	84	43	78	128	65				
		74			126			234			173				206			142	
	255						533									348			
				381						407									

JG	58	37	77	51	92	55	40	70	95	30	101	74	40	101	132				
		114			198			205			205				141			205	
	327						608									346			
				525						410									

JF	97	18	80	55	83	90	86	110	111	45	100	105	72	153	105				
		98			228			307			250				225			202	
	370						785									427			
				598						557									

DP	91	69		37	63	41	34	70	75	20	74	56	50	80	65				
		69			141			179			150				130			135	
	236						470									265			
				377						329									

j o p a r a p e n 's a r e ŋ k a

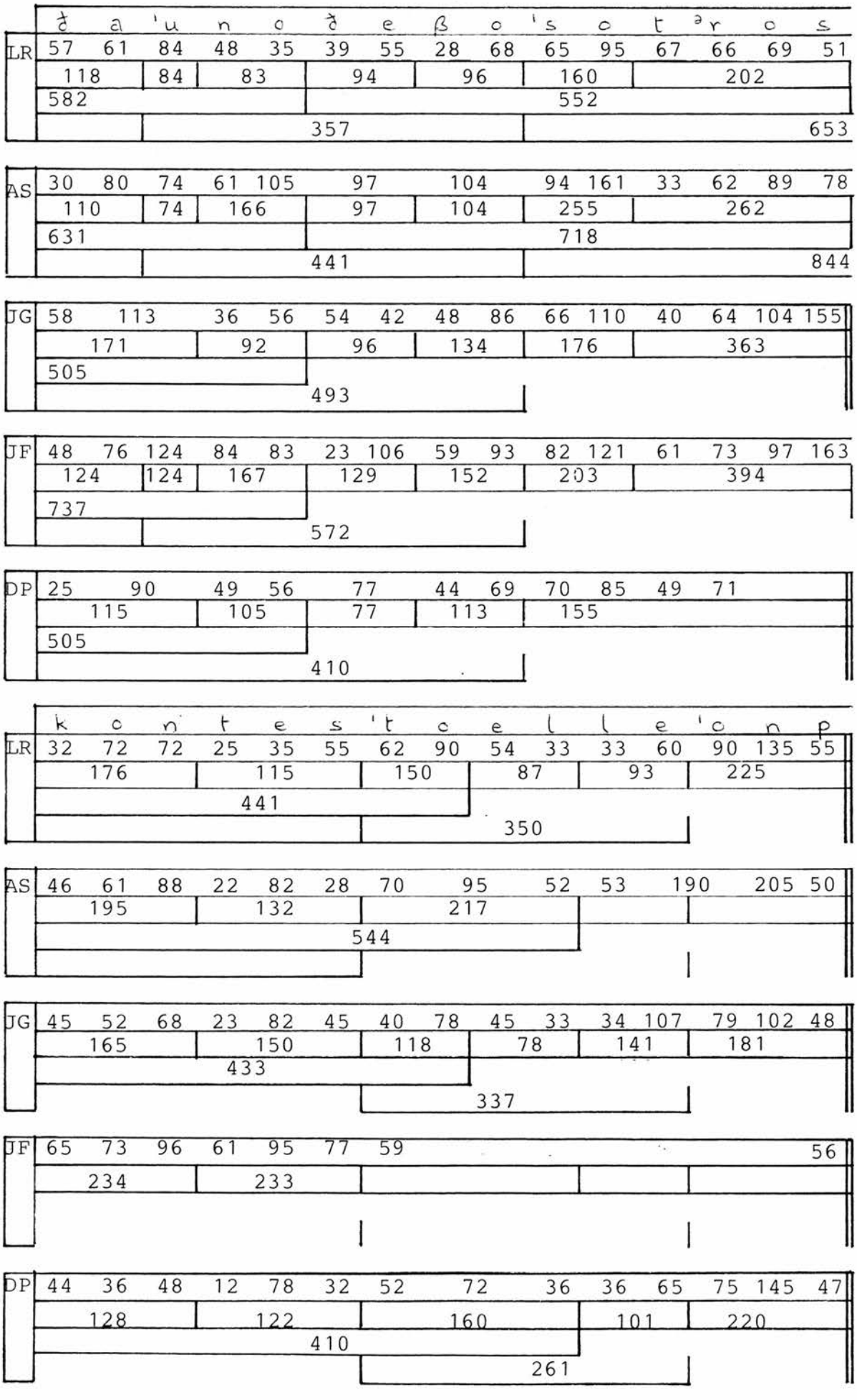
LR	138	30	69	27	81	48	112	93	62	85	36	64	110	38	85				
		99		108		253			183			174		123					
					643														
	894												598						

AS	77	29	63	23	100	38	102	64	50	81	29	65	89	28	89				
		92		123		204			160			154		127					
					579														
	767												551						

JG	73	39	70	33	60	38	65	100	77	98	41	62	43	45	92				
		109		93		203			216			105		137					
					621														
	751												458						

JF	97	66	79	35	78	70	63	131	66	95	30	80	80	47	115				
		145		113		264			191			160		162					
					713														
	949												637						

DP	70	45	45	32	63	47	77	40	82	111	86		60	95	30	100			
		90		95		164			279				155		130				
	614																		


ð a 'u n o ð e β o 's o t ³r o s
LR 57 61 84 48 35 39 55 28 68 65 95 67 66 69 51
118 84 83 94 96 160 202
582 552
357 653
AS 30 80 74 61 105 97 104 94 161 33 62 89 78
110 74 166 97 104 255 262
631 718
441 844
JG 58 113 36 56 54 42 48 86 66 110 40 64 104 155
171 92 96 134 176 363
505
493
JF 48 76 124 84 83 23 106 59 93 82 121 61 73 97 163
124 124 167 129 152 203 394
737
572
DP 25 90 49 56 77 44 69 70 85 49 71
115 105 77 113 155
505
410
k o n' t e s 't o e l l e 'o n p
LR 32 72 72 25 35 55 62 90 54 33 33 60 90 135 55
176 115 150 87 93 225
441
350
AS 46 61 88 22 82 28 70 95 52 53 190 205 50
195 132 217
544
JG 45 52 68 23 82 45 40 78 45 33 34 107 79 102 48
165 150 118 78 141 181
433
337
JF 65 73 96 61 95 77 59 56
234 233
DP 44 36 48 12 78 32 52 72 36 36 65 75 145 47
128 122 160 101 220
410
261

e r o p a r a ž e m o s ' t ° r a

LR	65	27	74	47	79	24	53	80		60	57	39	38	56	68		
	120		101		126		77		80		156			219			

AS	61	29	92	35	86	20	78	74		80	89	41	52	68	96		
	111		121		121		98		74		210			239			

JG	152	25	130	76	67	27	45	42	43	55	96	55	39	55	60		
	200		155		143		72		85		206			178			

JF	80	38	72	73	87	27	66	38	86	72	112	82	50	69	131		
	136		110		160		93		124		266			278			

DP	71	18	57	40		86		40	65	49	101	45	29	66	73		
	118		75		126			105		195			195				

r o z m je s 'p i r i t u ž e s

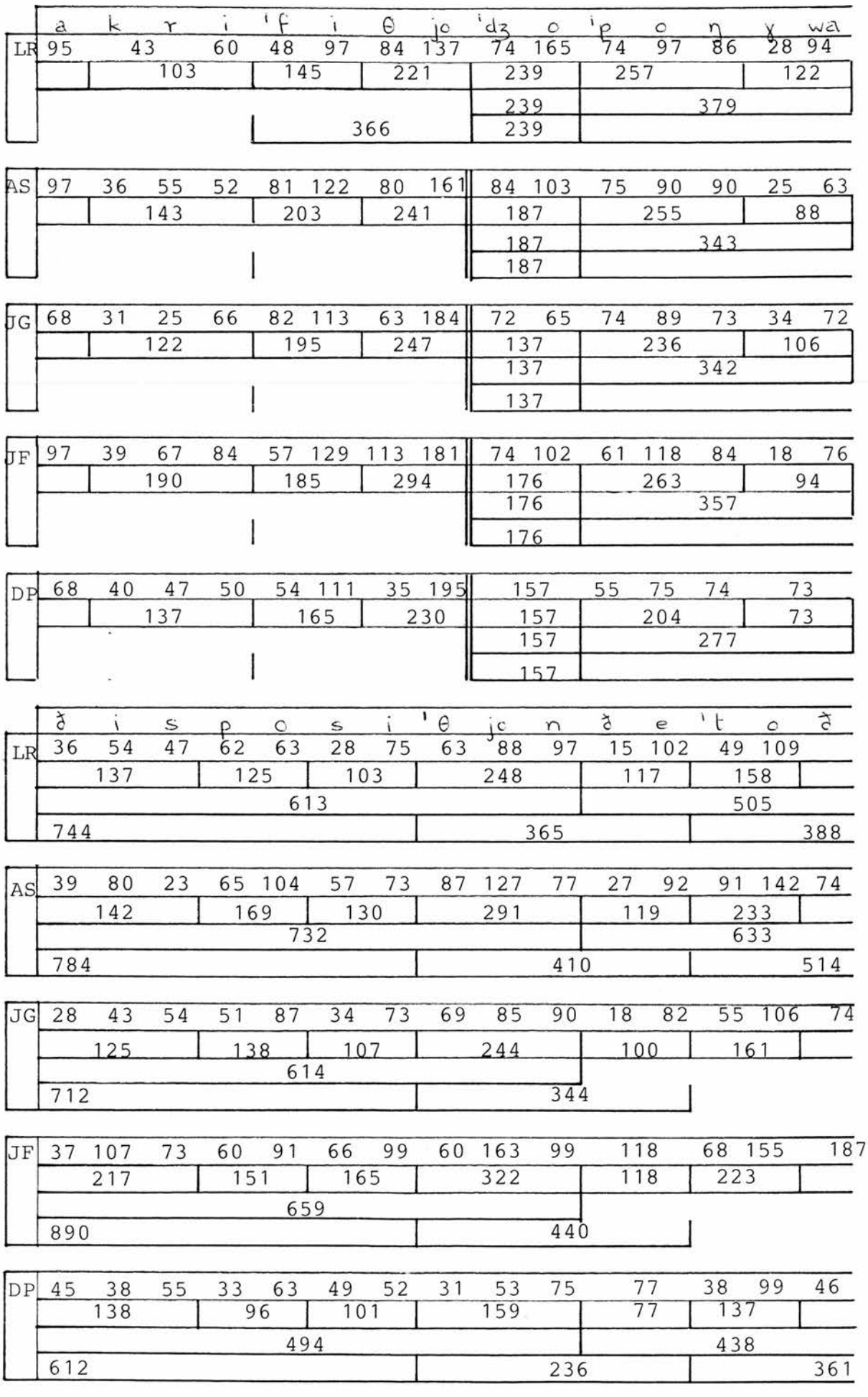
LR	57	71	29	116	126	48	45	52	42	66	22	73		98	63					
		100			290		97		108		95			98		158				
								590												
			609																	

AS	23	61	65	41	95	38	72	73	29	83	44	55		92	31					
		126			174		145		112		99			92		128				
								530												
			539																	

JG	24	81	35	90	61	59	47	53	27	78	40	60		70	47					
		116			210		100		105		100			70		115				
								515												
			504																	

JF	28	129	123	73	88	97	75	68	37	110	46	92		97	68					
					258		143		147		138			97						
								686												

DP	27	127	77	68	112	51	46	26	32	75	25	55		61	39					
		204			231		72		107		80			61		107				
								490												


a k r i 'f i θ jc 'dʒ o 'p o n ɣ wa
LR 95 43 60 48 97 84 137 74 165 74 97 86 28 94
103 145 221 239 257 122
239 379
366 239
AS 97 36 55 52 81 122 80 161 84 103 75 90 90 25 63
143 203 241 187 255 88
187 343
187
JG 68 31 25 66 82 113 63 184 72 65 74 89 73 34 72
122 195 247 137 236 106
137 342
137
JF 97 39 67 84 57 129 113 181 74 102 61 118 84 18 76
190 185 294 176 263 94
176 357
176
DP 68 40 47 50 54 111 35 195 157 55 75 74 73
137 165 230 157 204 73
157 277
157
ð i s p o s i 'θ jc n ð e 't o ð
LR 36 54 47 62 63 28 75 63 88 97 15 102 49 109
137 125 103 248 117 158
613 505
744 365 388
AS 39 80 23 65 104 57 73 87 127 77 27 92 91 142 74
142 169 130 291 119 233
732 633
784 410 514
JG 28 43 54 51 87 34 73 69 85 90 18 82 55 106 74
125 138 107 244 100 161
614
712 344
JF 37 107 73 60 91 66 99 60 163 99 118 68 155 187
217 151 165 322 118 223
659
890 440
DP 45 38 55 33 63 49 52 31 53 75 77 38 99 46
138 96 101 159 77 137
494 438
612 236 361

o z ˈg ˀr a n d e s iˈtʃ i k o s

LR	230		31	59	90	61	22	83	33	111	90	113	64	85	47		
	230			241			138			111		203		196			
					378								510				
						489										618	

AS	91	116	75	54	123	90	18	89	83	37	138	109	80	140	80		
	281			342			190			37		247		300			
					532												
						569											

JG	116		72	60	71	57	28	89	38	92	90	82	53	120	140		
				260			155			92		172		313			
					415												
						507											

JF		150	114	86	130	130	47	107	130	88	128	115	65	159	134		
				460			284			88		243		358			
					744												
						832											

DP	89	89	60	148		54	28	47	43	89	44	117		30	143	104	
	224			262			118			89		161		277			
					380												
						469											

e m p e ˈθ a n d o p o r l o s

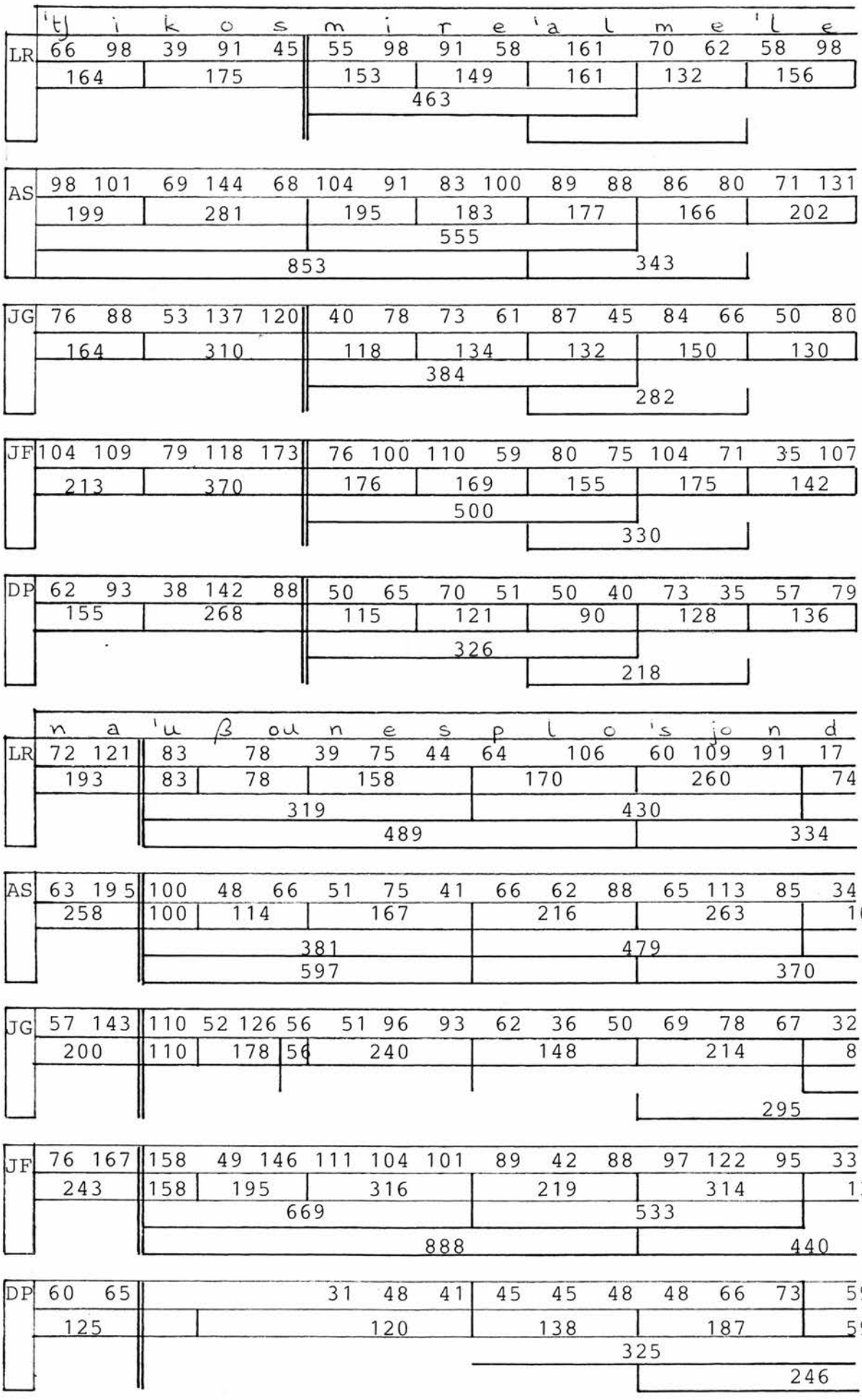
LR	68	57	36	58	52	80	44	20	44	39	69		44	46	35		
	125		94		176			64		108			125				
						459											
							473										

AS	68	82	30	87	62	97	69	20	74	25	68	37	65	48	52		
	150		117		228			94		130			165				
				589											775		
						617											

JG	50	51	28	83	46	91	54	23	83	36	64	35	40	68	43		
	101		111		191			106		135			151				
				509													
						583											

JF	64	95	45	108	77	115	105	21	74	75	96	34	85	105	59		
	159		153		297			95		205			249				
				704													
						846											

DP	35	60	10	75	36	44	43	25	48	19	45	29		82	49		
	95		85		123			73		93			131				
				376													
						420											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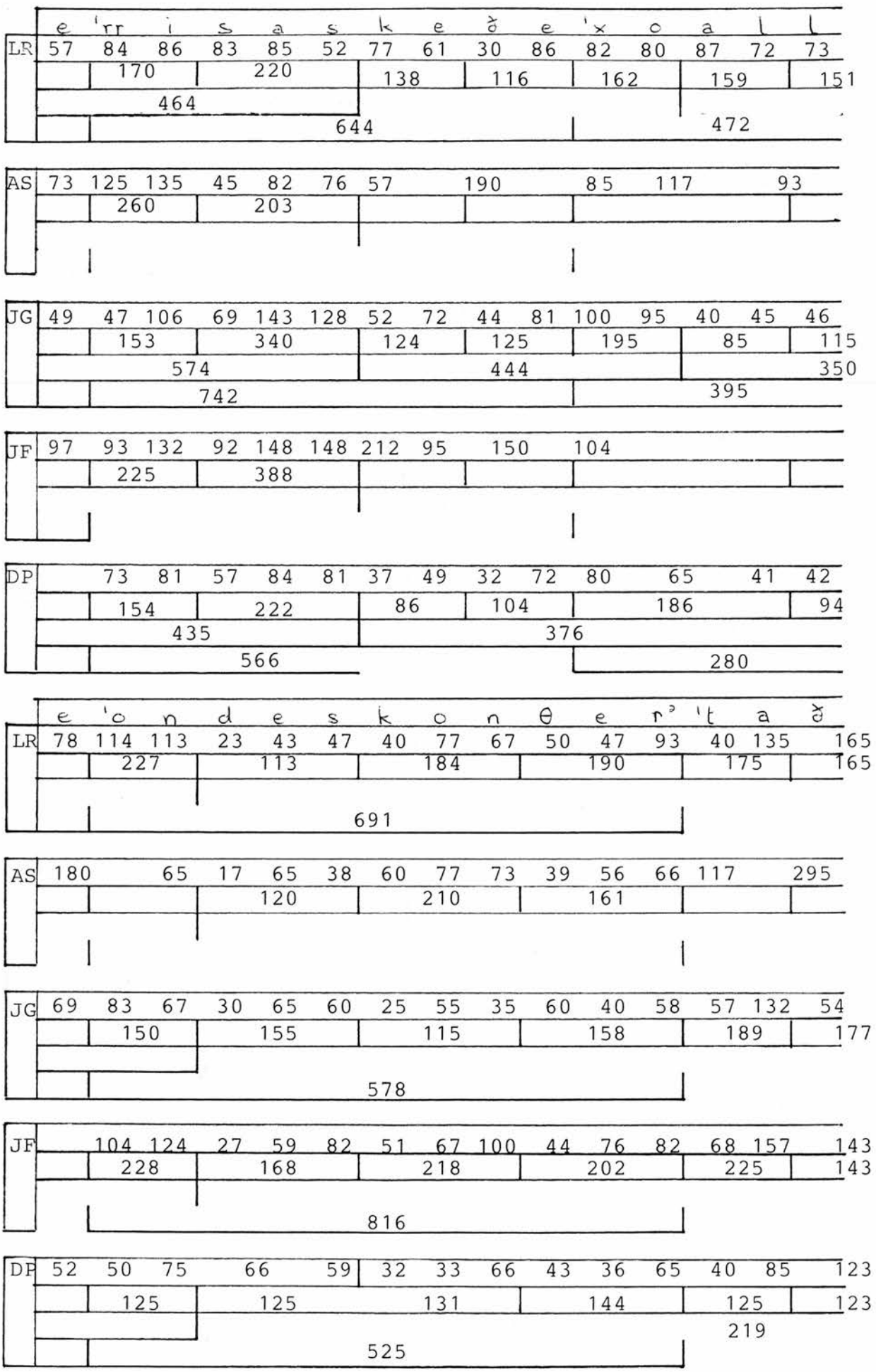
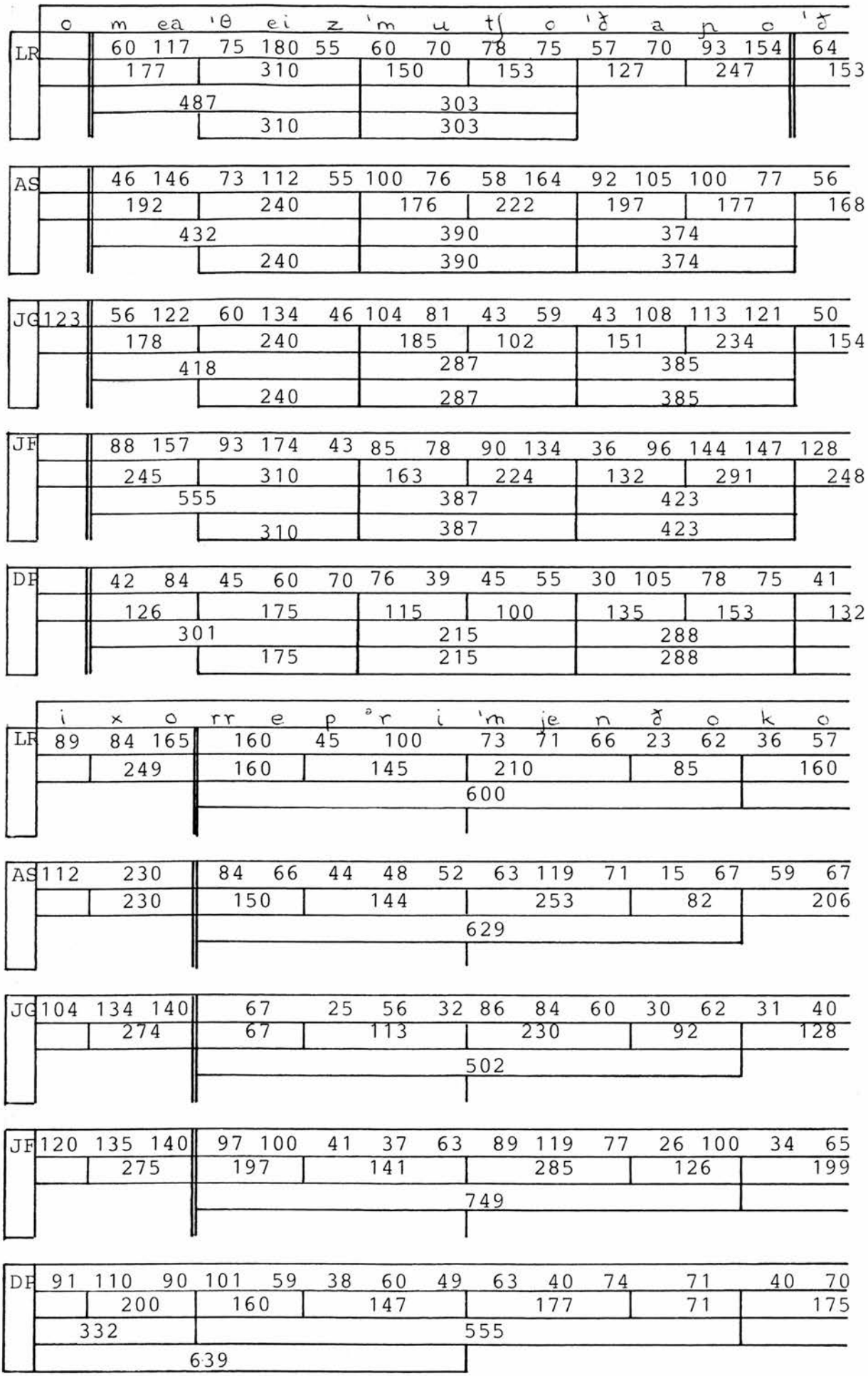
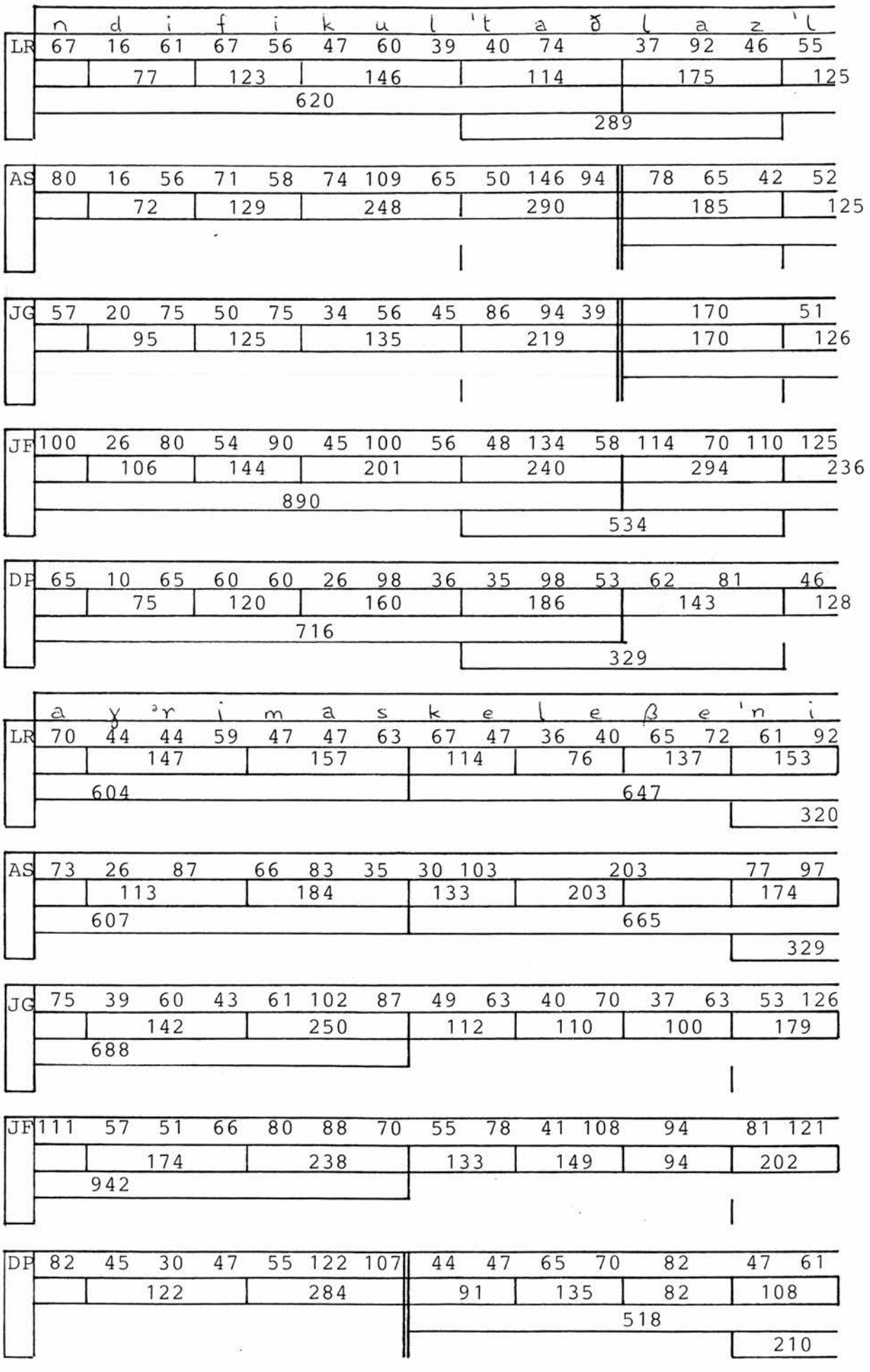
LR 66 98 39 91 45 55 98 91 58 161 70 62 58 98
164 175 153 149 161 132 156
463
AS 98 101 69 144 68 104 91 83 100 89 88 86 80 71 131
199 281 195 183 177 166 202
555
853 343
JG 76 88 53 137 120 40 78 73 61 87 45 84 66 50 80
164 310 118 134 132 150 130
384
282
JF 104 109 79 118 173 76 100 110 59 80 75 104 71 35 107
213 370 176 169 155 175 142
500
330
DP 62 93 38 142 88 50 65 70 51 50 40 73 35 57 79
155 268 115 121 90 128 136
326
218
n a 'u β ou n e s p l o 's jo n d
LR 72 121 83 78 39 75 44 64 106 60 109 91 17
193 83 78 158 170 260 74
319 430
489 334
AS 63 195 100 48 66 51 75 41 66 62 88 65 113 85 34
258 100 114 167 216 263 107
381 479
597 370
JG 57 143 110 52 126 56 51 96 93 62 36 50 69 78 67 32
200 110 178 56 240 148 214 81
295
JF 76 167 158 49 146 111 104 101 89 42 88 97 122 95 33
243 158 195 316 219 314 130
669 533
888 440
DP 60 65 31 48 41 45 45 48 48 66 73 59
125 120 138 187 59
325
246

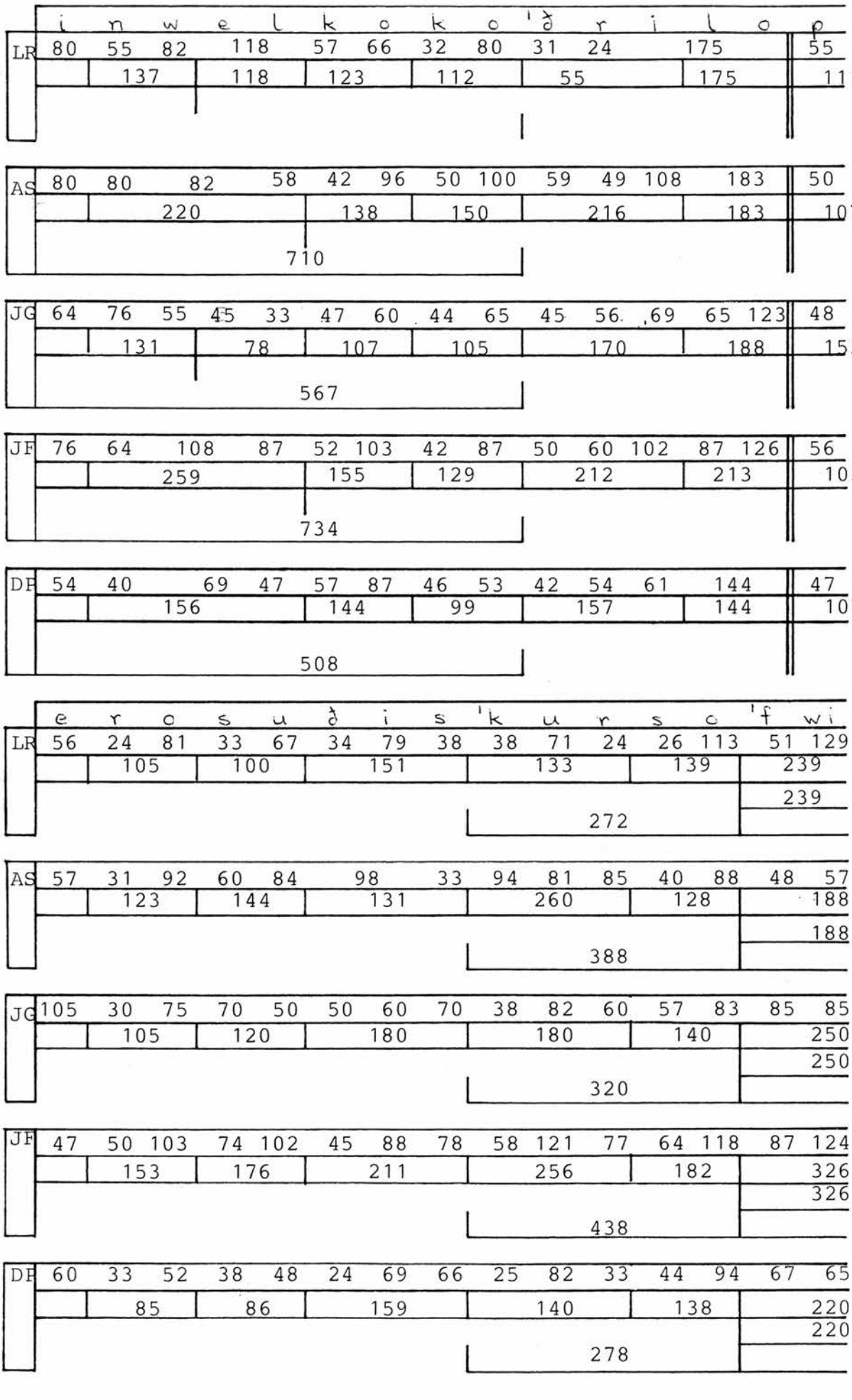

e 'rr i s a s k e ð e 'x o a l l
LR 57 84 86 83 85 52 77 61 30 86 82 80 87 72 73
170 220 138 116 162 159 151
464
644
472
AS 73 125 135 45 82 76 57 190 85 117 93
260 203
JG 49 47 106 69 143 128 52 72 44 81 100 95 40 45 46
153 340 124 125 195 85 115
574 444 350
742 395
JF 97 93 132 92 148 148 212 95 150 104
225 388
DP 73 81 57 84 81 37 49 32 72 80 65 41 42
154 222 86 104 186 94
435 376
566 280
e 'o n d e s k o n θ e r ' t a ð
LR 78 114 113 23 43 47 40 77 67 50 47 93 40 135 165
227 113 184 190 175 165
691
AS 180 65 17 65 38 60 77 73 39 56 66 117 295
120 210 161
JG 69 83 67 30 65 60 25 55 35 60 40 58 57 132 54
150 155 115 158 189 177
578
JF 104 124 27 59 82 51 67 100 44 76 82 68 157 143
228 168 218 202 225 143
816
DP 52 50 75 66 59 32 33 66 43 36 65 40 85 123
125 125 131 144 125 123
219
525


o m ea 'θ ei z 'm u tʃ o 'ð a ɲ o 'ð
LR 60 117 75 180 55 60 70 78 75 57 70 93 154 64
177 310 150 153 127 247 153
487 303
310 303
AS 46 146 73 112 55 100 76 58 164 92 105 100 77 56
192 240 176 222 197 177 168
432 390 374
240 390 374
JG 123 56 122 60 134 46 104 81 43 59 43 108 113 121 50
178 240 185 102 151 234 154
418 287 385
240 287 385
JF 88 157 93 174 43 85 78 90 134 36 96 144 147 128
245 310 163 224 132 291 248
555 387 423
310 387 423
DP 42 84 45 60 70 76 39 45 55 30 105 78 75 41
126 175 115 100 135 153 132
301 215 288
175 215 288
i x o rr e p ˚r i 'm je n ð o k o
LR 89 84 165 160 45 100 73 71 66 23 62 36 57
249 160 145 210 85 160
600
AS 112 230 84 66 44 48 52 63 119 71 15 67 59 67
230 150 144 253 82 206
629
JG 104 134 140 67 25 56 32 86 84 60 30 62 31 40
274 67 113 230 92 128
502
JF 120 135 140 97 100 41 37 63 89 119 77 26 100 34 65
275 197 141 285 126 199
749
DP 91 110 90 101 59 38 60 49 63 40 74 71 40 70
200 160 147 177 71 175
332 555
639


n d i f i k u l 't a ð l a z 'l
LR 67 16 61 67 56 47 60 39 40 74 37 92 46 55
77 123 146 114 175 125
620
289
AS 80 16 56 71 58 74 109 65 50 146 94 78 65 42 52
72 129 248 290 185 125
JG 57 20 75 50 75 34 56 45 86 94 39 170 51
95 125 135 219 170 126
JF 100 26 80 54 90 45 100 56 48 134 58 114 70 110 125
106 144 201 240 294 236
890
534
DP 65 10 65 60 60 26 98 36 35 98 53 62 81 46
75 120 160 186 143 128
716
329
a y 'r i m a s k e l e ß e 'n i
LR 70 44 44 59 47 47 63 67 47 36 40 65 72 61 92
147 157 114 76 137 153
604
647
320
AS 73 26 87 66 83 35 30 103 203 77 97
113 184 133 203 174
607
665
329
JG 75 39 60 43 61 102 87 49 63 40 70 37 63 53 126
142 250 112 110 100 179
688
JF 111 57 51 66 80 88 70 55 78 41 108 94 81 121
174 238 133 149 94 202
942
DP 82 45 30 47 55 122 107 44 47 65 70 82 47 61
122 284 91 135 82 108
518
210

	a	n	'n	o	s	e	's	a	β	e	p	o	r	'k	e	
LR	84	83	78	89	66	80	55	69	119	52	37	78	36	107		
	167		167		146		124		119	167			143			
			167		389					310						
			313				410									
AS	110	45	45	67	58	66	70	41	100	46	57	100	50	116		
	155		112		124		111		100	203			166			
			112		335					369						
			236				414									
JG	76	113	44	94	32	87	90	75	33	87	75	90	29	41	88	
	189		138		119		165		120	194			129			
			138		404					323						
			257						479							
JF	70	110	107	122	81	108	94	111	37	128	45	69	109	54	111	
	180		229		189		205		165	223			165			
			229		559					388						
			418						593							
AS	62	40	56	59	22	91	63	101	86	69	51	27	30	110		
	102		115		113		164		86	147			140			
			115		363					287						
			228						397							

	k	o	n	'd	u	y	t	o	d	e	s	u	β	e	'θ	
LR	27	60	130	18	112	37	77	137	56	76	75	78	87		80	
	217			167			214		132		153		87		160	
	360															
AS	37	95	132	15	75	58	100	90	108	64	78		118		122	
	264			148			190		108	142			118		202	
			602						790							
	430					706										
JG	22	70	60	48	67	63	117	174	32	102	39	45	44	78	82	
	152			178			291		134		84		122		146	
													617			
	281															
JF	37	89	132	39	81	84	102	148	52	90	89	74	47	100	115	
	258			204			250		142		163		147		191	
													902			
	423															
DP	33	65	62	33	66	49	49	67	109	44	51	36	94	55		
	160			148			116		109	95			130		109	
			424										599			
	300					598										


i n w e l k o k o ˈð r i l o p
LR 80 55 82 118 57 66 32 80 31 24 175 55
137 118 123 112 55 175 111
AS 80 80 82 58 42 96 50 100 59 49 108 183 50
220 138 150 216 183 107
710
JG 64 76 55 45 33 47 60 44 65 45 56 69 65 123 48
131 78 107 105 170 188 153
567
JF 76 64 108 87 52 103 42 87 50 60 102 87 126 56
259 155 129 212 213 103
734
DP 54 40 69 47 57 87 46 53 42 54 61 144 47
156 144 99 157 144 107
508
e r o s u ð i s ˈk u r s o ˈf wi
LR 56 24 81 33 67 34 79 38 38 71 24 26 113 51 129
105 100 151 133 139 239
239
272
AS 57 31 92 60 84 98 33 94 81 85 40 88 48 57
123 144 131 260 128 188
188
388
JG 105 30 75 70 50 50 60 70 38 82 60 57 83 85 85
105 120 180 180 140 250
250
320
JF 47 50 103 74 102 45 88 78 58 121 77 64 118 87 124
153 176 211 256 182 326
326
438
DP 60 33 52 38 48 24 69 66 25 82 33 44 94 67 65
85 86 159 140 138 220
220
278

	n	t	e	rr	u	m	'p	i	ð	o	p	o	r	l	o
LR	59	22	66	77	46	82	42	65	44	89	50	42	19	52	51
		88		205			107		131		111			204	
					531										
					532						553				

AS	83	27	70	66	47	104	66	99	61	87	53	45	35	70	74
		97		217			165		148		133			230	
					627									823	
					502						676				

JG	80	27	64	66	30	83	50	98	52	137	83	94	33	43	75
		91		179			148		189		210			188	
					607									703	
					520						735				

JF	115	21	78	70	86	94	68	112		96	50	102	51	49	113
		99		250			180		96		203			267	
					625									963	
					675						746				

DP	88	16	50	93	46	63	50	95	39	67	48	51	20	104	
		76		202			145		106		119			119	
					529									513	
					498						489				

	s	'u	rr	a	s	a	l	o	s	'a	ŋ	x	e	l	e
LR	101	88	99	148	58	65	50	77	106	95	75	80	51	61	110
		88		305		65		233		170		131		271	

AS	86	160	120	120	60	102	43	95	75	108	94	43	60	35	95
		160		300		102		213		202		103		204	
									775						

JG	70	75	60	90	80	56	40	61	74	59	95	95	74	54	39
		75		230		56		175		154		169		203	
										757					
									536				873		

JF	105	115	103	137	138	82	60	100	75	103	98	74	52	43	109
		115		378		82		235		201		126		258	
									810						

DP	115	61	98	56	60	60	86		46	70	73	75	37	45	102
		61		214		60		132		143		112		243	
									467						

s i s u s 'θ e s t a z ð e p ˀr

LR	100	85	90	83	60	60	77	62	59	74	53	52	66	20	66				
		85		233			199			186			118		142				
						703													
											734								
AS	74	103	40	100	55	56	127	44	77		99		97		50	63			
		103		195			227			176			97		163				
						701													
											783								
JG	110	123	75	89	60	45	93	67	39	49	42	30	60	33	52				
		123		224			205			130			90		137				
						682													
											665								
JF	106	61	96	106	56	57	105	45	65	67	33	54	61	69	61				
		61		258			207			165			115		217				
						691													
											836								
DP	96	76	52	95	55	40	89	28	39	44	22	23	75	43	24				
		76		202			157			105			98		110				
						540													
											612								

o β i 's jo n e s 's i 't o ð u 'β

LR	56	27	62	111	114		225					38	98	46	90	40			
		89		225			225						136		136				
														272					
														272					
AS	50	56	64	127	150		65		145			48	70	29	70	50			
		120		277			210						118		99				
														217					
														217					
JG	52	43	60	80	106		61		118	154		44	105	49	112	63			
		103		186			333						149		161				
														310					
														310					
JF	87		132		95	147		69		89		63	109	59	140	70			
		132		242									172		199				
														371					
														371					
DP	43	67	75	43	95		320					41	120		79	29			
		142		138			320						141		79				
														220					
														220					

je r a 's i ð o p e r 'f e y t o

LR	149	26	98	102	85	25	60	60	34	54	77	75	65	60	105		
	189		124		187		85		148			217			165		
	317				272												
	317				420												

AS	105	24	108	73	80	70	72	59	73	89	90	76	78	72			
	155		132		153		70		204			255			150		
	287				223				609								
	287				427									576			

JG	79	21	90	53	52	41	66	58	46	84	60	100	80	80	143		
	142		111		105		107		188			240			223		
	253				212												
	253				400												

JF	120	32	119	94	48	47	107	53	74	116	70	109	69	112	130		
	190		151		142		154		243			248			242		
	341				296												
	341				539												

DP	67	24	93	68	62	30	57	58	28	60	80	56	44	62	78		
	96		117		130		87		146			180			140		
	213				217				466								
	213				363									468			

s i n 'e s t a 'k u ß j a k e 'n a

LR	100	69	42	71	52	37	76	57	82	46	141	45	56	53	81		
	211			123		113		139		187		104		134			
	447							326				238					
				236				430									

AS	93	78		78	37	62	96	43	119	41	150	66	41	73	63		
	171			115		158		162		191		107		136			
	444							353				243					
				273				460									

JG	11	45	65	88	42	45	75	78	92	61	134	55	40	46	40		
	221			130		120		170		195		95		86			
	471							365				181					
				250				460									

JF	130	75	60	139	76	50	79	91	101	79	167	49	77	43	98		
	265			215		129		192		246		126		141			
	609							438				267					
				344				564									

DP	31	54	63	77	32	30	81	72	74	46	119	68	32	38	77		
	148			109		111		146		165		100		115			
	368							311				215					
				220				411									

p a 'r a β a x a 'm a s n i 'u n

LR	22	60	31	77	30	68	69	57	65	130	225		78	64	83	57						
	82		108		98		126		420				142		140							
	288												282									
	216		332												292							
AS	51	80	35		247		53	70	115		237		68	54		130						
	131						123		352				122		130							
													252									
	267														297							
JG	61	83	30	78	42	64	90	44	67	115	123		70		157		43					
	144		108		106		134		305				270									
	358												270									
	230		348												433							
JF	72	68	33	94	48	74	80	72	84	100			86	53		152						
	140		127		122		152						291									
	389												291									
	281		401												467							
DP	34	55	37	43		64	119	44	57	106	164		65		70		71					
	89		80		64		163		327				206									
	233												206									
	204		307												353							

s e 'γ u n d o 's e k o e n l a

LR	73	79	67		106	14	80	86	108	34		108	37	33	43							
	152		173			94		194		179					114							
	419							373														
			267					720														
AS	80	87	51	132	130	10	146						69	89		100						
	167		313			156							158			100						
JG	74	89	29	53	76	29	86	72	100	98	157		30	68	37	47						
	163		158			115		172		255			98			124						
	436																					
			273																			
JF	69	107	37	95	108	24	125	95	155	32		109	113	56	65							
	176		240			149		250		254					181							
	565							504														
			389																			
DP	66	81	85		85		90	70	108	69	146		47	64	55	37						
	147		170			90		178		215			111			120						
	407																					
			260																			

z ß ei n t i 'k wa 't ª r o r a z ð

| | | |

APPENDIX 7

Data of word in "chico" series, Chapter VI

	(t)ʃ	i	k	o
LR Seg	72	105	29	101
Syl	177		130	
Word	307			
AS Seg	69	97	43	105
Syl	166		148	
Word	314			
JG Seg	57	100	35	129
Syl	157		164	
Word	321			
JF Seg	77	97	57	113
Syl	174		170	
Word	344			
DP Seg	68	94	27	122
Syl	162		149	
Word	311			

	ˈ(p)o	n
LR Seg	93	88
Syl	181	
Word	181	
AS Seg	178	67
Syl	245	
Word	245	
JG Seg	123	135
Syl	258	
Word	258	
JF Seg	117	118
Syl	235	
Word	235	
DP Seg	117	106
Syl	223	
Word	223	

	ˈ(p)o	ŋ	g	a
LR Seg	90	64	13	72
Syl	154		85	
Word	239			
AS Seg	101	78	17	108
Syl	179		125	
Word	304			
JG Seg	88	89	30	118
Syl	177		148	
Word	325			
JF Seg	75	101	30	105
Syl	176		135	
Word	311			
DP Seg	86	82	84	
Syl	168		84	
Word	252			

	(t)ʃ	i	ˈk	i	t	o
LR Seg	87	67	131		24	79
Syl	154		131		103	
Word	388					
AS Seg	47	61	45	99	58	112
Syl	108		144		170	
Word	422					
JG Seg	54	82	74	120	42	115
Syl	136		194		157	
Word	487					
JF Seg	50	85	58	87	86	94
Syl	135		145		180	
Word	460					
DP Seg	70	64	23	98	25	94
Syl	131		121		119	
Word	374					

	ˈ(p)o	ŋ	g	a	s	e
LR Seg	80	60	69		36	90
Syl	140		69		126	
Word	335					
AS Seg	84	100	12	98	69	93
Syl	184		110		162	
Word	456					
JG Seg	74	80	30	95	67	83
Syl	154		125		150	
Word	429					
JF Seg	84	74	22	90	68	92
Syl	158		112		160	
Word	430					
DP Seg	67	76	78		24	106
Syl	143		78		130	
Word	351					

	(t)ʃ	i	k	i	ˈt	i	ʌo
LR Seg	64	65	87		44	105	107
Syl	129		87		149		107
Word	472						
AS Seg	47	66	47	90	74	136	128
Syl	113		137		210		128
Word	588						
JG Seg	53	83	62	102	30	111	55 118
Syl	136		164		141		173
Word	614						
JF Seg	43	63	33	111	52	120	170
Syl	106		144		172		170
Word	592						
DP Seg	63	69	31	73	37		
Syl	132		104		252		
Word	488						

	ˈ(p)o	ŋ	g	a	s	e	l	a
LR Seg	69	55	73		73	42	26	53
Syl	124		73		115		79	
Word	391							
AS Seg	89	101	99		60	95	52	63
Syl	190		99		155		115	
Word	559							
JG Seg	64	80	103		50	90	45	95
Syl	144		103		140		140	
Word	527							
JF Seg	77	61	22	100	80	51	114	
Syl	138		122		131		114	
Word	505							
DP Seg	73	71	68		65	74	79	
Syl	144		68		139		79	
Word	430							

	m	i		m	i	t	o
LR Seg	81	73		72	86	38	66
Syl	154			158		104	
Word	154			262			
AS Seg	78	94		56	97	53	102
Syl	172			153		155	
Word	172			308			
JG Seg	84	171		58	105	43	102
Syl	255			163		145	
Word	255			308			
JF Seg	70	90		74	97	50	107
Syl	160			171		157	
Word	160			328			
DP Seg	66	117		89	84	36	100
Syl	183			173		136	
Word	183			309			

	b	i		b	i	n	o
LR Seg	81	120		72	93	55	65
Syl	201			165		120	
Word	201			285			
AS Seg	76	136		50	100	54	104
Syl	212			150		158	
Word	212			308			
JG Seg	85	185		80	87	48	110
Syl	270			167		158	
Word	270			325			
JF Seg	103	134		100	87	63	101
Syl	237			187		164	
Word	237			351			
DP Seg	45	137		27	54	54	105
Syl	182			81		159	
Word	182			240			

	a	ð	m	i	t	o
LR Seg	81		136	88	24	77
Syl	81		224		101	
Word	406					
AS Seg	105		54	75	52	109
Syl	105		129		161	
Word	395					
JG Seg	80	30	75	90	30	118
Syl	110		165		148	
Word	423					
JF Seg	114		110	86	40	98
Syl	114		196		138	
Word	448					
DP Seg	108		70	65	19	109
Syl	108		135		128	
Word	371					

	d	i	β	i	n	o
LR Seg	37	130	108		66	59
Syl	167		108		125	
Word	400					
AS Seg	64	75	55	91	60	103
Syl	139		146		163	
Word	448					
JG Seg	54	65	50	107	38	107
Syl	119		157		145	
Word	421					
JF Seg	37	75	71	78	54	105
Syl	112		149		159	
Word	420					
DP Seg	71	53	25	76	61	83
Syl	124		101		144	
Word	369					

	r	e	a	ð	m	i	t	o
LR Seg	160				109	77	25	76
Syl					186		101	
Word	447							
AS Seg	257				95	93	71	86
Syl					188		157	
Word	602							
JG Seg	290				90	80	55	92
Syl					170		147	
Word	607							
JF Seg	260				79	75	50	100
Syl								
Word								
DP Seg	197				65	50	15	101
Syl					115		116	
Word	428							

	a	ð	i	β	i	n	o
LR Seg	84	135		100		63	52
Syl	84	135		100		115	
Word	434						
AS Seg	83	39	81	50	62	72	109
Syl	83	120		112		181	
Word	496						
JG Seg	110	30	78	42	94	45	116
Syl	110	108		136		161	
Word	515						
JF Seg	70	45	95	50	86	49	95
Syl	70	140		136		144	
Word	490						
DP Seg	55	55	84	32	55	45	88
Syl	55	139		87		133	
Word	414						

	e	n
LR Seg	128	105
Syl	233	
Word	233	
AS Seg	117	110
Syl	227	
Word	227	
JG Seg	118	132
Syl	250	
Word	250	
JF Seg	106	112
Syl	218	
Word	218	
DP Seg	90	125
Syl	215	
Word	215	

	e	n	t	e
LR Seg	90	75	54	81
Syl	165		135	
Word	300			
AS Seg	106	82	99	96
Syl	188		195	
Word	383			
JG Seg	87	102	44	96
Syl	189		140	
Word	329			
JF Seg	104	79	38	95
Syl	183		133	
Word	316			
DP Seg	83	96	27	95
Syl	179		122	
Word	301			

	a
LR Seg	160
Syl	160
Word	160
AS Seg	200
Syl	200
Word	200
JG Seg	168
Syl	168
Word	168
JF Seg	200
Syl	200
Word	200
DP Seg	147
Syl	147
Word	147

	a	n	o
LR Seg	140	65	74
Syl	140	139	
Word	279		
AS Seg	100	71	88
Syl	100	159	
Word	259		
JG Seg	112	58	94
Syl	112	152	
Word	264		
JF Seg	144	66	90
Syl	144	156	
Word	300		
DP Seg	79	52	89
Syl	79	141	
Word	220		

	e	n	t	e	r	o
LR Seg	38	70	61	92	45	73
Syl	108		153		118	
Word	379					
AS Seg	73	107	42	84	28	105
Syl	180		126		133	
Word	439					
JG Seg	84	97	45	101	30	101
Syl	181		146		131	
Word	458					
JF Seg	73	70	70	68	147	
Syl	143		138		147	
Word	428					
DP Seg	41	97	20	83	32	103
Syl	138		103		135	
Word	376					

	b	e	r	a	n	o
LR Seg	91	96	28	127	57	72
Syl	187		155		129	
Word	471					
AS Seg	27	80	38	100	45	120
Syl	107		138		165	
Word	410					
JG Seg	61	71	30	100	56	109
Syl	132		130		165	
Word	427					
JF Seg	35	75	34	106	68	80
Syl	110		140		148	
Word	398					
DP Seg	43	80	24	76	60	72
Syl	123		100		132	
Word	355					

	e	n	t	e	r	a	s	e
LR Seg	48	64	33	69	32	97	83	70
Syl	112		102		129		153	
Word	496							
JG Seg	61	129	32	90	22	113	88	97
Syl	190		122		135		185	
Word	632							
JG Seg	76	78	35	86	24	111	49	103
Syl	154		121		135		152	
Word	562							
JF Seg	66	65	44	71	35	108	94	85
Syl	131		115		143		179	
Word	568							
DP Seg	50	103	25	69	33	100	65	76
Syl	153		94		133		141	
Word	521							

	s	o	b	e	r	a	n	o
LR Seg		71	106		33	96	43	88
Syl			106		129		131	
Word	437							
JG Seg	73	69	33	77	31	101	55	85
Syl	142		110		132		140	
Word	524							
JG Seg	109	80	43	63	32	102	51	110
Syl	189		106		134		161	
Word	590							
JF Seg		68	42	78	30	95	60	80
Syl			120		125		140	
Word	453							
DP Seg		51	95		34	82	49	65
Syl			95		116		114	
Word	376							

	m	i
LR Seg	115	140
Syl	255	
Word	255	
AS Seg	60	131
Syl	191	
Word	191	
JG Seg	81	119
Syl	200	
Word	200	
JF Seg	87	109
Syl	196	
Word	196	
DP Seg	73	145
Syl	218	
Word	218	

	m	i	s	a
LR Seg	40	110	78	71
Syl	150		149	
Word	299			
AS Seg	75	106	59	140
Syl	181		199	
Word	380			
JG Seg	80	80	46	115
Syl	160		161	
Word	321			
JF Seg	80	85	95	90
Syl	165		185	
Word	350			
DP Seg	36	108	34	89
Syl	144		123	
Word	267			

	(k)a	m	i	s	a
LR Seg	114	53	82	83	65
Syl	114	135		148	
Word	397				
AS Seg	90	70	96	59	108
Syl	90	166		167	
Word	423				
JG Seg	83	87	84	49	117
Syl	83	171		166	
Word	420				
JF Seg	80	84	69	94	90
Syl	80	153		184	
Word	417				
DP Seg	97	66	60	30	109
Syl	97	126		139	
Word	362				

	(k)a	m	i	s	e	t	a
LR Seg	102	41	75	85	95	45	56
Syl	102	116		180		101	
Word	499						
AS Seg	103	86	67	62	115	40	109
Syl	103	153		177		149	
Word	582						
JG Seg	75	86	80	60	91	60	105
Syl	75	166		151		165	
Word	557						
JF Seg	77	67	73	95	80	40	115
Syl	77	140		175		155	
Word	547						
DP Seg	94	68	50	48	95	27	88
Syl	94	118		143		115	
Word	470						

	(k)a	m	i	s	e	t	i	ka
LR Seg	92	35	60	79	81	50	80	106
Syl	92	95		160		130		106
Word	583							
AS Seg	90	56	74	60	110	47	103	163
Syl	90	130		170		150		163
Word	703							
JG Seg	79	75	71	49	86	43	89	188
Syl	79	146		135		132		188
Word	680							
JF Seg	80	68	50	80	80	70	133	164
Syl	80	118		160		203		164
Word	725							
DP Seg	98	52	44	49	58	32	228	
Syl	98	96		107		260		
Word	561							

NOTE ON TERMINOLOGY

The following definitions apply to the terms as used in this study:

Stressed syllables: Syllables which native speakers of the languages concerned marked as more prominent than the others when listening to recordings of the texts.

Accented syllables: Syllables which would be stressed in individual words uttered in citation form.

Stress groups : Groups of syllables containing one stressed syllable, optionally flanked by, preceded by or followed by a number of unstressed syllables, according to the type of analysis and language. The term does not necessarily imply a rhythmic unit.

Leader-timing : Analysis into stress groups in which the stressed syllable occupies the first position in the group.

Trailer-timing : Analysis into stress groups in which the stressed syllable occupies the last position in the group.

Word-group-timing : Analysis into stress groups using syntactic criteria to establish boundaries. Stressed syllable usually central to the group (Spanish) but may occupy any position.

Fixed stress : Stress usually occurring on the same syllable in each word, e.g. final syllable in French.

Tone Group : "A stretch of speech which lasts, on average, for about seven or eight syllables, and which contains only one very prominent syllable, on which a major change of pitch occurs in intonation" (Laver, 1970 : 68). In certain Spanish tone groups, the prominent syllable may be distinguished by other phonetic features.

Sinalefa : The collapsing of two adjacent vowels into one syllable across a word boundary in Spanish.

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List of abbreviations used in Bibliography

OUP Oxford University Press

UCLA University of California, Los Angeles

JASA Journal of the Acoustical Society of America

CUP Cambridge University Press

IRAL International Review of Applied Linguistics

MIT Massachusetts Institute of Technology

UCL University College, London

ELTJ English Language Teaching Journal.

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